

The Mineral Industries Experiment Station
College of Mineral Industries
The Pennsylvania State University

Circular No.67

Bibliography - Geochemistry of the Stable Isotopes of
Carbon and Oxygen

Jon N. Weber

University Park, Pennsylvania

BIBLIOGRAPHY - GEOCHEMISTRY
OF THE STABLE ISOTOPES OF
CARBON AND OXYGEN

Jon N. Weber

Department of Geochemistry and Mineralogy
The Pennsylvania State University

August, 1964

This bibliography comprises a collection of references to abstracts and papers of possible interest to geochemists and isotope geologists. Major sources of information included Chemical Abstracts, Meteorological and Geoastrophysical Abstracts, Geoscience Abstracts, Mineralogical Abstracts, Solid State Abstracts, and the Bibliography of North American Geology; these journals were searched up to August, 1964.

Preparation of the bibliography was supported by the National Science Foundation, under Grant G-18947 supervised by Dr. M. L. Keith.

CARBON
1

- (1) ABELSON, P.H. and HOERING, T.C. (1960) Biogeochemistry of the stable isotopes of carbon: Bull. Geol. Soc. Amer., v. 71, 1811
- (2) ABELSON, P.H. and HOERING, T.C. (1961) Carbon isotope fractionation in formation of amino acids by photosynthetic organisms: Proc. Natl. Acad. Sci. U.S., v. 47, 623-632
- (3) ADEL'BERG, I.M. (1963) A precise method for the determination of isotope ratios of light elements: Tr. Vses. Neft. Nauchn.-Issled. Geologorazved. Inst. No. 212, 234-245
- (4) ADEL'BERG, I.M. and DVALI, M.F. (1961) The geochemical examination of petroleum by isotope analysis: Tr. Vses. Neft. Nauchn.-Issled. Geologorazved. Inst. No. 174, 186-98
- (5) ADLER, H.H. (1958) Application of isotopic data to problems of uranium geology: Proc. U.N. Intern. Conf. Peaceful Uses Atomic Energy, 2nd, Geneva, 1958, v. 2, 224-229
- (6) ANCONA, E., BOATO, G. and CASANOVA, G. (1962) Vapor pressure of isotopic liquids IV; CO, N, O above the boiling point: Nuovo Cimento, v. 24, 111-121
- (7) ATTREE, R.W., BROWN, F., DUNN, G.E. and LOUNSBURY, M. (1954) Isotope effects in the combustion of carbon monoxide: Can. J. Chem., v. 32, 921-930
- (8) AZCONA, J.M.L.d. (1953) Geophysical interpretation of natural isotopic variations of the chemical elements: Rev. cienc. apl. (Madrid), v. 7, 193-202
- (9) AZCONA, J.M.L.d. (1955) Natural isotopic variations of the chemical elements: Rev. cienc. apl. (Madrid), v. 9, 193-207
- (10) BAERTSCHI, P. (1951) Relative abundances of oxygen and carbon isotopes in carbonate rocks: Nature, v. 168, 288-289
- (11) BAERTSCHI, P. (1952) The fractionation of the isotopes of carbon during the absorption of carbon dioxide: Helv. Chim. Acta, v. 35, 1030-1036

- (12) BAERTSCHI, P. (1953) Fractionation of naturally occurring isotopes in carbon dioxide exchange in green plants: *Helv. Chim. Acta*, v. 36, 773-781
- (13) BAERTSCHI, P. (1957) Measurement and interpretation of the relative variations of abundance of oxygen-18 and carbon-13 in carbonate rocks and minerals: *Schweiz. mineral. petrog. Mitt.*, v. 37, 73-152
- (14) BECKER, E.W. and BIER, K. (1952) Chemical isotope separation process as a rectification problem: *Z. Naturforsch.*, v. 7a, 651-664
- (15) BECKER, E.W., BIER, K., SCHOLZ, S. AND VOGELL, W. (1952) Experience with a chemical exchange set-up for the enrichment of carbon-13: *Z. Naturforsch.*, v. 7a, 664-668
- (16) BECKER, E.W. and VOGELL, W. (1950) The natural distribution of carbon-13 and oxygen-18 and the redistribution of the isotopes in the solution equilibrium: hydrocyanic acid - glacial acetic acid: *Z. Naturforsch.*, v. 5a, 174-175
- (17) BECKER, E.W., VOGELL, W. and ZIGAN, F. (1953) Self diffusion of nitrogen and carbon dioxide at high pressures: *Z. Naturforsch.*, v. 8a, 686-694
- (18) BERNSTEIN, R.B. (1952) Enrichment of isotopes by difference in rates for irreversible isotopic reactions: *J. Phys. Chem.*, v. 56, 893-896
- (19) BIDELMAN, W.P. (1954) On the carbon and S-type stars: *Mem. Soc. Roy. Sci. Liège*, v. 14, 402
- (20) BIGELEISEN, J. (1948) Theory of isotope effects in chemical reaction rates: Brookhaven Conf. Rept., Isotopic exchange reactions and chem. kinetics: *Chem. Conf.* No. 2, 53-75
- (21) BIGELEISEN, J. (1952) The effects of isotopic substitutions on the rates of chemical reactions: *J. Phys. Chem.*, v. 56, 823-828
- (22) BOATO, G. (1953) Isotopic abundances in rocks and meteorites: *Bull. Geol. Soc. Amer.*, v. 64, 1396

- (23) BOATO, G. (1954) The isotopic composition of hydrogen and carbon in the carbonaceous chondrites: *Geochimica et Cosmochimica Acta*, v. 6, 209-220
- (24) BOATO, G., CASANOVA, G. and LEVI, A. (1962) Isotope effect in phase equilibria: *J. Chem. Phys.*, v. 37, 201
- (25) BOBROVNIKOFF, N.T. (1930) Carbon isotopes in comets: *Astron. Soc. Pacific Publ.*, v. 42, 117
- (26) BOBROVNIKOFF, N.T. (1939) Molecular bands in stellar spectra: *Astrophys. J.* v. 89, 301-310
- (27) BOND, D.C. (1962) Geochemical prospecting for petroleum: U.S. Patent No. 3,033,287, 8 pp.
- (28) BOWEN, H.J.M. (1960) Biological fractionation of isotopes: *Intl. Jour. Applied Radiation and Isotopes*, v. 7, 261
- (29) BRADLEY, D.C. (1954) Fractionation of isotopes by distillation of some organic substances: *Nature*, v. 173, 260-261
- (30) BROSI, A.R. and HARKINS, W.D. (1937) The abundance ratio of the isotopes in natural or isotopically separated carbon: *Phys. Rev.*, v. 52, 472-474.
- (31) BROWN, H. (1957) The carbon cycle in nature: *Fortsch. Chem. Org. Naturstoffe*, v. 14, 317-333
- (32) BUCHANAN, D.L., NAKAO, A. and EDWARDS, G. (1953) Carbon isotope effects in biological systems: *Science*, v. 117, 541-545
- (33) CALVIN, M. and WEIGL, J.W. (1952) Concentrating isotopic carbon: U.S. Patent No. 2,602, 047
- (34) CAMERON, A.G.W. (1955) Origin of anomalous abundances of the elements in giant stars: *Astrophys. J.*, v. 121, 144-160
- (35) CAMERON, A.G.W. (1959) Carbon thermonuclear reactions and the formation of heavy elements: *Astrophys. J.*, v. 130, 429-451

- (36) CAMERON, A.G.W. (1959) A revised table of abundances of the elements: *Astrophys. J.*, v. 129, 676-699
- (37) CARSON, S.F. (1948) Design and interpretation of carbon isotope experiments in bacterial metabolism: *Cold Spring Harbor Quant. Biol.*, v. 13, 75-80
- (38) CASAS, J. and SAVIRON, J.M. (1961) Theory of isotope separation by thermal diffusion: *Rev. Acad. Cienc. Exact., Fis.-Quim. Nat. Zaragoza*, v. 16, 117-151
- (39) CHENEY, E.S. and JENSEN, M.L. (1963) Stable carbon isotopes of calcite in the Gas Hills, Wyoming, Uranium district: *Geol. Soc. Amer. Spec. Paper* 76, 31-32
- (40) CHENG, C.H. (1963) Uses of stable isotopes: *Hua Hsueh Tung Pao*, No. 9, 550-555
- (41) CLAYTON, R.N. (1963) Carbon isotope abundance in meteoritic carbonates: *Science*, v. 140, 192-193
- (42) CLAYTON, R.N. and DEGENS, E.T. (1959) Use of carbon isotope analyses of carbonates for differentiating freshwater and marine sediments: *Bull. Amer. Assoc. Petrol. Geol.*, v. 43, 890-895
- (43) CLUSIUS, K. and BÜHLER, H.H. (1954) The separation tube XIII. Preparation of the heavy carbon isotope C^{13} in pure state: *Z. Naturforsch.*, v. 9a, 775-783
- (44) CLUSIUS, K. and DICKEL, G. (1950) Separation Tube VIII. Enrichment of carbon 13 in methane: *Helv. Phys. Acta*, v. 23, 103-107
- (45) CLUSIUS, K., ENDTINGER, F. and SCHLEICH, K. (1960) Results of low-temperature research XXX. Vapor pressure difference of $C^{12}H_4$ and $C^{13}H_4$ between the melting and the boiling point: *Helv. Chim. Acta*, v. 43, 1267-1274
- (46) CLUSIUS, K., SCHLEICH, K., ENDTINGER, F., BERNSTEIN, R. and VOGELMANN, M. (1963) Relation of the vapor pressures in the systems $C^{12}H_4/C^{13}H_4/C^{12}H_3D$; $N_2^{14}/O^{15}N^{14}O$; SO^{16}_2/SO^{18}_2 ; and Ar^{36}/Ar^{40} : *J. Chim. Phys.*, v. 60, 66-69

- (47) COMPSTON, W. (1960) Carbon isotopic compositions of certain marine invertebrates and coals from the Australian Permian: *Geochim. et Cosmochim. Acta*, v. 18, 1-22
- (48) COOK, A.C. (1961) Isotopic carbon compositions of certain marine invertebrates and coals from the Australian Permian: *Geochim. et Cosmochim. Acta*, v. 22, 289-290
- (49) COOK, K.L. (1943) The relative abundance of the isotopes of K in Pacific kelps and in rocks of different geologic ages: *Phys. Rev.*, v. 64, 278-293
- (50) CRAIG, H. (1953) The geochemistry of the stable carbon isotopes: *Geochimica et Cosmochimica Acta*, v. 3, 53-92
- (51) CRAIG, H. (1953) *Corycium defunctum*: the non-indicative properties of isotopes and review articles: *Econ. Geol.*, v. 48, 600-603
- (52) CRAIG, H. (1953) Isotopic geochemistry of hot springs: *Bull. Geol. Soc. Amer.*, v. 64, 1410
- (53) CRAIG, H. (1953) Application of "natural" isotopic tracer and dilution techniques to geological problems: *Proc. Conf. Nuclear Processes in Geol. Settings*, Univ. Chicago, Natl. Research Council, Natl. Sci. Foundation, 1953, 76-78
- (54) CRAIG, H. (1954) Carbon-13 variations in *Sequoia* rings and the atmosphere: *Science*, v. 119, 141-143
- (55) CRAIG, H. (1954) Carbon-13 in plants and the relation between carbon¹³ and carbon¹⁴: *J. Geol.*, v. 62, 115-149
- (56) CRAIG, H. (1955) Chemical implications of isotopic composition of carbon in ancient rocks: *Geochimica et Cosmochimica Acta*, v. 6, 186-196
- (57) CRAIG, H. (1957) Isotopic standards for carbon and oxygen and correction factors for mass spectrometric analysis of carbon dioxide: *Geochimica et Cosmochimica Acta*, v. 12, 133-149

CARBON
6

- (58) CRAIG, H (1961) Carbon 12, 13 and 14 concentrations in volcanic gases: Amer. Geophys. Union 1961 First Western National Meeting. Preprints, p. 43
- (59) CRAIG, H. and BOATO, G. (1955) Isotopes: Ann. Rev. Phys. Chem., v. 6, 403-432
- (60) CRAIG, H. and KEELING, C.D. (1963) Effects of atmospheric NO₂ [sic] on the measured isotopic composition of atmospheric CO₂: Geochimica et Cosmochimica Acta, v. 27, 549-551
- (61) CURRIE, J.B. (1951) The occurrence and relationships of some mica and apatite deposits in southeastern Ontario: Economic Geology, v. 46, 765-778
- (62) DANSGAARD, W. (1953) Comparative measurements of standards for carbon isotopes: Geochimica et Cosmochimica Acta, v. 3, 253-256
- (63) DAUDIN, A. and FEHRENBACH, C. (1946) The carbon isotope C¹³ in stars of classes R and N: Compt. rend., v. 222, 1083-1085
- (64) DAVENPORT, A.N. and WINTER, E.R.S. (1951) Diffusion properties of gases. V. Thermal diffusion of carbon monoxide, nitrogen and methane: Trans: Faraday Soc., v. 47, 1160-1169
- (65) DAVIDSON, C.N., MANN, C.K. and SHELINE, R.K. (1963) The fractionation of carbon isotopes by ion exchange employing a formic acid system: J. Phys. Chem., v. 67, 1519-1524
- (66) DECIUS, J.C. (1954) Intermolecular coupling of out-of-plane bending mode in several carbonates: J. Chem. Phys., v. 22, 1946
- (67) DEEVEY, E.S. Jr., NAKAI, N. and STUIVER, M. (1963) Fractionation of sulfur and carbon isotopes in a meromictic lake: Science, v. 139, 407-408
- (68) DEGENS, E.T. and EPSTEIN, S. (1961) Stable isotope studies on marine and continental dolomites from recent and ancient sediments: Geol. Soc. Amer. Spec. Paper 68, 160

- (69) DEGENS, E. T. and EPSTEIN S. (1964) Oxygen and carbon isotope ratios in coexisting calcites and dolomites from recent and ancient sediments: *Geochimica et Cosmochimica Acta*, v. 28, 23-44
- (70) DEGENS, E. T., PIERCE, W. D. and CHILINGAR, G. V. (1962) Origin of petroleum-bearing fresh-water concretions of Miocene age: *Bull. Amer. Assoc. Petrol. Geol.*, v. 46, 1522-1525
- (71) DESSAU , G., GONFIANTINI, R. and TONGIORGI, E. (1959) The origin of the Italian sulfur deposits in the light of isotopic analyses of carbonate rocks from the gypsum-sulfur series of Sicily: *Boll. Serv. Geol. Ital.*, v. 81, 313-348
- (72) DEVYATYKH, G. G. (1958) The application of a statistical method for calculating the effect of isotopes on vapor pressure: *Trudy Khim. i. Khim. Tehknol.*, v. 1, 239-249
- (73) DEVYATYKH, G. G. and ZORIN, A. D. (1956) The determination of the relative vapor pressures of C^{13}H_4 and O^{18} ₂ by the Rayleigh distillation method: *Zhur. Fiz. Khim.*, v. 30, 1133-1139
- (74) DEVYATYKH, G. G., ZORIN, A. D. and NIKOLAEV, N. I. (1958) Separation of carbon and oxygen isotopes by fractional distillation of carbon monoxide, methane and molecular oxygen: *Zhur. Priklad. Khim.*, v. 31, 368-375
- (75) DIBELER, V. H. (1956) Isotope reference sample program at the National Bureau of Standards: *Natl. Acad. Sci. - Natl. Research Council Publ.* No. 400, 55-61
- (76) DOBRONRAVIN, P. P. (1950) Heavy carbon in the stellar atmospheres: *Nauka i Zhizn*, No. 4, 26-28
- (77) DUFAY, J. (1946) The carbon isotope C^{13} in comets: *Compt. rend.*, v. 223, 783-784
- (78) ECKELMANN, W. R., LUPTON, R. A., WHITLOCK, D. W. and ALLSUP, J. R. (1961) Carbon isotopic composition of the total organic carbon of some recent sediments: *Geol. Soc. Amer. Spec. Paper* 68, 169

- (79) ECKELMANN, W. R., BROECKER, W. S., WHITLOCK, D. W. and ALLSUP, J. R. (1962) Implications of carbon isotopic composition of some recent sediments and ancient oils: Bull. Amer. Assoc. Petrol. Geol., v. 46, 699-704
- (80) ECKERMAN, H. v., UBISCH, H. v. and WICKMAN, F. E. (1952) A preliminary investigation into the isotopic composition of carbon from some alkaline intrusions: Geochimica et Cosmochimica Acta, v. 2, 207-210
- (81) ENGEL, A. E. J., CLAYTON, R. N. and EPSTEIN, S. (1958) Variations in isotopic composition of oxygen and carbon in Leadville limestone (Mississippian, Colorado) and in its hydrothermal and metamorphic phases: Jour. Geology, v. 66, 374-393
- (82) EPSTEIN, S. (1953) Mass spectrometer for the measurement of small differences in isotope abundance ratios: Natl. Bur. Standards (U.S.) Circ. No. 522, 133-139
- (83) EYRING, H. and CAGLE, F. W., Jr. (1952) The significance of isotopic reactions in rate theory: J. Phys. Chem., v. 56, 889-892
- (84) FEELY, H. W. and KULP, J. L. (1957) Origin of Gulf Coast salt-dome sulfur deposits: Bull. Amer. Assoc. Petrol. Geol., v. 41, 1802-1853
- (85) FLECK, R. N. (1957) Isotope separation processes: U. S. Patent No. 2, 780, 526
- (86) FRERICHS, R. (1938) The ratio of C^{12}/C^{13} of the isotopes in diamonds: Z. Physik. Chem., v. A181, 355-358
- (87) FRIDMAN, V. G. (1940) Distribution of carbon isotopes Priroda 1940, 65
- (88) GAVELIN, S. (1957) Variations in isotopic composition of carbon from metamorphic rocks in Northern Sweden and their geological significance: Geochim et Cosmochim. Acta, v. 12, 297-314
- (89) GOLDBERG, L., MOHLER, O. C. and McMATH, R. R. (1948) Isotopes of carbon and oxygen in the earth's atmosphere: Phys. Rev., v. 74, 1881-1882

- (90) GRAF, D. L. (1960) Geochemistry of carbonate sediments and sedimentary carbonate rocks IV-A. Isotopic composition and chemical analyses: Ill. State Geol. Survey, Circ. No. 308, 42 pp
- (91) GREENSTEIN, J. L., RICHARDSON, R. S. and SCHWARZSCHILD, M. (1950) The abundance of carbon in the solar atmosphere: Pub. Astron. Soc. Pacific, v. 62, 15-18
- (92) GRINBERG, I. V., PETRIKOVSAYA, M. E. and AREF'EV, N. V. (1961) Chemical-genetic properties and isotopic relations of gas condensate hydrocarbons in the Carpathian Region: Geol. Sb., L'vovsk. Geol. Obshchestvo pri L'vovsk. Gos. Univ. No. 7-8, 54-65.
- (93) GROSS, G. M. (1961) O^{18}/O^{16} and C^{13}/C^{12} ratios of diagenetically altered limestones in the Bermuda Islands, Bikini and Eniwetok atolls: Geol. Soc. Amer. Spec. Paper 68, 187
- (94) GROSS, M. G. (1964) Variations in the O^{18}/O^{16} and C^{13}/C^{12} ratios of diagenetically altered limestones in the Bermuda Islands: J. Geol., v. 72, 170-194
- (95) GROTH, W., MURRENHOFF, A. and BUKOW, H. H. (1963) Prototype element separator for a multipurpose thermodiffusion isotope separator for gases: Ber. Kernforschungsanlage Juelich No. 46, 38 pp.
- (96) GUREVICH, L. E. and LEBEDINSKII, A. I. (1955) The reasons for stellar explosions: Doklady Akad. Nauk U.S.S.R., v. 103, 569-572
- (97) HAHN-WEINHEIMER, P. (1960) Boron and carbon content of basic to intermediate metamorphites of the Münchberg gneiss massif and their Cl^2/Cl^3 ratios: Intern. Geol. Congr., Rept. 21st Session, Copenhagen, Pt. 13, 431-442
- (98) HAHN-WEINHEIMER, P. (1960) Age of eclogitic rocks by means of C^{13}/C^{12} isotope ratios of graphite and carbonate carbons: Geol. Rundschau, v. 49, 308-314
- (99) HAUL, R. A. W. (1952) The thermal decomposition of dolomite crystals - a solid state reaction: Proc. Intern. Symposium Reactivity of Solids, Gothenburg, Pt. 1, 431-441

CARBON
10

- (100) HAUL, R. A. W. (1953) Solid-state reactions and their bearing on industrial chemical processes: S. African Ind. Chemist, v. 7, 211-213
- (101) HAUL, R. A. W. and STEIN, L. H. (1955) Diffusion in calcite crystals on the basis of isotopic exchange with carbon dioxide: Trans. Faraday Soc., v. 51, 1280-1290
- (102) HAUL, R. A. W., STEIN, L. H. and LOUW, J. D. (1951) Exchange of carbon¹³ dioxide between solid carbonates and gaseous carbon dioxide: Nature, v. 167, 241-242
- (103) HAUL, R. A. W., STEIN, L. H. and de VILLIERS, J. W. L. (1953) Exchange of carbon¹³ dioxide between calcite crystals and gaseous carbon dioxide: Nature, v. 171, 619-620
- (104) HAYAKAWA, T. (1951) The mass spectrometric determination of isotopes I. The abundance ratio of carbon-13 in magnesium carbonate and formic acid: J. Chem. Soc. Japan, v. 72, 187-188
- (105) HAYAKAWA, T. (1953) Kinetics of the isotopic exchange reactions between carbon monoxide and carbon dioxide: Bull. Chem. Soc. Japan, v. 26, 165-172
- (106) HERINGTON, E. F. G. (1950) The preparation and certification of standard hydrocarbon samples: Mass Spectrometry (London), 157-169
- (107) HERINGTON, E. F. G. (1950) Synthesis with carbon-13: Mass Spectrometry (London), 157-169
- (108) HOERING, T. C. (1961) Carbon isotope ratios in carbonates and reduced carbons from ancient sediments: Geol. Soc. Amer. Spec. Paper 68, 199
- (109) HOERING, T. C. (1961) The effect of physical changes on isotope fractionation: Carnegie Inst. Washington, Papers Geophys. Lab., No. 1363, 201-204
- (110) HOERING, T. C. (1961) The carbon isotope effect in the synthesis of diamond. Carnegie Inst. Washington, Papers Geophys. Lab., No. 1363, 204

- (111) HOERING, T. C. (1963) Stable isotopes of carbon and the organic compounds in Precambrian sedimentary rocks: Natl. Acad. Sci.-Natl. Res. Council Publ. No. 1075, 196-208
- (112) HOERING, T. C. and ABELSON, P. H. (1961) Carbon isotope effects in aerobic metabolism of micro-organisms: Carnegie Inst. Washington, Papers Geophys. Lab. No. 1363, 199-200
- (113) HOLMES, A. (1958) Spitskop carbonatite, Eastern Transvaal: Bull. Geol. Soc. Amer., v. 69, 1525-1526
- (114) HORIBE, Y. (1952) Concentration of heavy carbon by the thermal diffusion of methane: J. Chem. Soc. Japan, v. 73, 75-76
- (115) HORIBE, Y. and NISHIZAWA, S. (1955) Concentration of heavy carbon by thermal diffusion of methane II J. Chem. Soc. Japan, v. 76, 25-28
- (116) HULSTON, J. R. and McCABE, W. J. (1962) Mass-spectrometer measurements of the thermal areas of New Zealand Part I Carbon dioxide and residual gas analysis; Part II Carbon isotopic ratios: Geochimica et Cosmochimica Acta, v. 26, 383-397; 399-410
- (117) INGERSON, E. (1953) Non-radiogenic isotopes in geology: a review: Bull. Geol. Soc. Amer., v. 64, 301-374
- (118) JAMES, H. L. (1959) General features of stable isotope research as applied to problems of ore deposits: Bull. Geol. Soc. Amer., v. 70, 1623
- (119) JANSEN, H. S. (1962) Depletion of C^{13} in young Kauri tree: Nature, 196, 84-85
- (120) JEFFERY, P. M., COMPSTON, W., GREENHALGH, D. and DE LAETER, J. (1955) The carbon-13 abundance of limestones and coals: Geochimica et Cosmochimica Acta, v. 7, 255-286
- (121) JENKINS, F. A. and KING, A. S. (1936) A test of the abundance of the heavy isotope carbon in a graphite meteorite: Astron. Soc. Pacific Publ. 48, 323

- (122) JENKINS, F. A. and WOOLDRIDGE, D. E. (1938) Mass ratio of the carbon isotopes from the spectrum of CN: Phys. Rev., v. 53, 137-140
- (123) JENSEN, M. L. (1953) Geologic importance of variations in stable isotope abundances: Econ. Geol., v. 48, 161-176
- (124) JENSEN, M. L. and NAKAI, N. (1962) Geology and isotopic studies of Sicilian sulfur deposits: Econ. Geol., v. 57, 410-438
- (125) JOHNS, T. F., KRONBERGER, H. and LONDON, H. (1950) Enrichment of the heavy isotopes of carbon and oxygen by fractional distillation of carbon monoxide: Mass Spectrometry (London), 141-147
- (126) JOHNSTON, H. S., BONNER, W. A. and WILSON, D. J. (1957) Carbon isotope effect during oxidation of carbon monoxide with nitrogen dioxide: J. Chem. Phys., v. 26, 1002-1006
- (127) JONES, R.C. and FURRY, E.H. (1946) Separation of isotopes by thermal diffusion: Revs. Modern Phys., v. 18, 151-224
- (128) KEELING, C.D. (1958) The concentration and isotopic abundances of atmospheric carbon dioxide in rural areas: Geochim. et Cosmochim. Acta, v. 13, 322-334
- (129) KEELING, C.D. (1960) The concentration and isotopic abundances of carbon dioxide in the atmosphere: Tellus, v. 12, 717-723
- (130) KEELING, C.D. (1961) Concentration and isotopic abundances of carbon dioxide in rural and marine air: Geochim. et Cosmochim. Acta, v. 24, 277-298
- (131) KEELING, C.D. (1961) Mechanism for cyclic enrichment of carbon-12 by terrestrial plants: Geochim. et Cosmochim. Acta, v. 24, 299-313
- (132) KEITH, M.L. and ANDERSON, G.M. (1962) Isotopic within-shell variation in mollusks in relation to their environment: Geol. Soc. Amer. Spec. Paper 73, 185

- (133) KEITH, M.L. and ANDERSON, G.M. (1963) Radiocarbon dating:fictitious results with mollusk shells: Science, v. 141, 634-637
- (134) KEITH, M.L. and ANDERSON, G.M. (1964) Radiocarbon dating of mollusk shells: a reply: Science, v. 144, 890
- (135) KEITH, M.L. and DEGENS, E.T. (1959) Geochemical indicators of marine and fresh-water sediments: in, Researches in Geochemistry, ed. by P.H. Abelson, Wiley (London) 38-61
- (136) KEITH, M.L., EICHLER, R. and PARKER, R.H. (1960) Carbon and oxygen isotope ratios in marine and freshwater mollusk shells: Bull. Geol. Soc. Amer., v. 71, 1901-1902
- (137) KIGOSHI, K. (1953) The separation of isotopes by a countercurrent gaseous exchange column: Bull. Chem. Soc. Japan, v. 26, 288-293; 311-316
- (138) KISTEMAKER, J. (1953) Influence of fractionizing and viscosity effects in mass spectrometric gas-handling systems: Natl. Bur. Standards (U.S.) Circ. 522, 243-247
- (139) KLUYVER, J.C. and MILATZ, J.M. (1953) An infrared isotope analyzer: Physica, v. 19, 401-411
- (140) KREJCI-GRAF, K. and WICKMAN, F.E. (1960) Geochemical profile through the Lias alpha: Geochimica et Cosmochimica Acta, v. 18, 259-272
- (141) KRELL, E. (1957) Separation and application of stable isotopes. I. Preparation of stable isotopes as a distillation problem: Chem. Tech., v. 9, 333-340
- (142) LAGEMANN, R.T., NIELSEN, A.H. and DICKEY, F.P. (1947) The infrared spectrum and molecular constants of $C^{12}O^{16}$ and $C^{13}O^{16}$: Phys. Rev., v. 72, 284-289
- (143) LANDERGREN, S. (undated) Reports of the Swedish Deep-Sea Expedition, 1947-1948. The geochemistry of the North Atlantic sediment core No. 238: Göteborgs Kungl. Vetenskaps-och Vitterhets-Samhälle, v. 7, 125-148

- (144) LANDERGREN, S. (1954) The relative abundance of the stable carbon isotopes in marine sediments: Deep-Sea Research, v. 1, 98-119
- (145) LANDERGREN, S. (1955) A Note on the isotope ratio carbon-12/carbon-13 in metamorphosed alum shale: Geochimica et Cosmochimica Acta, v. 7, 240-241
- (146) LANDERGREN, S. (1957) Preliminary note on the isotopic composition of carbon in some Swedish rocks: Geol. Fören. i Stockholm Förh., v. 79, 274-275
- (147) LANDERGREN S. (1961) The content of carbon-13 in the graphite-bearing magnetite ores and associated carbonate rocks in the Norberg mining district, Central Sweden: Geol. Fören. i Stockholm Förh., v. 83, 151-156
- (148) LANG, W.B. (1959) The origin of some natural carbon dioxide gases: J. Geophys. Research, v. 64, 127-131
- (149) LLOYD, R.M. (1964) Variations in the oxygen and carbon isotope ratios of Florida Bay Molluscs and their environmental significance: J. Geol., v. 72, 84-111
- (150) LOVERING, T.S., McCARTHY, J.H. and FRIEDMAN, I. (1963) Significance of O^{18}/O^{16} and C^{13}/C^{12} ratios in hydrothermally dolomitized limestones and manganese carbonate replacement ores of the Drum Mountains, Juab Co., Utah: U.S. Geol. Surv. Prof. Paper No. 475-B, 1-9
- (151) LOWENSTAM, H.A. and EPSTEIN, S. (1957) On the origin of sedimentary aragonite needles of the Great Bahama Bank: J. Geol., v. 65, 364-375
- (152) LYNN, K.R. and YANKWICH, P.E. (1960) Method of studying isotope fractionation in both atoms of a forming carbon-carbon bond: Chem. and Ind., 117
- (153) MAASS, I. (1961) Isotope geology with hydrogen, carbon and oxygen: Ber. Geol. Ges. Deut. Demokrat. Rep., Gesamtgebiet. Geol. Wiss., v. 6, 408-418

- (154) MARMO, V. (1953) Shungite: a pre-Cambrian carbon: Geol. Fören. i. Stockholm Förh., v. 75, 89-96
- (155) MARS, K.E. (1951) A preliminary investigation of the relative abundance of the carbon isotopes in Swedish rocks: J. Geol., v. 59, 131-141
- (156) MCKELLAR, A. (1949) Isotopes in stellar atmospheres: Pub. Astron. Soc. Pacific, v. 61, 199-209
- (157) MCKELLAR, A. (1949) Intensities of isotopic carbon bands in the λ 6191 sequence of the Swan system for some R-type spectra: Astron. J., v. 54, 191
- (158) MCKELLAR, A. (1950) The carbon-12 to carbon-13 abundance ratio in stellar atmospheres: Pub. Astron. Soc. Pacific, v. 62, 110-112
- (159) MCKELLAR, A. (1957) Molecules in the solar system: Mem. Soc. Roy. Sci. Liege, v. 18, 15-30
- (160) MCKINNEY, C.R., McCREA, J.M., EPSTEIN, S., ALLEN, H.A. and UREY, H.C. (1950) Improvements in mass spectrometers for the measurement of small differences in isotope abundance ratios: Rev. Sci. Instruments, v. 21, 724-730
- (161) MELANDER, L. (1960) Isotope effects on reaction rates: Ronald Press (New York)
- (162) MENZEL, D.H. (1930) The identification and cosmic abundance of carbon isotopes: Astron. Soc. Pacific Publ. 42, 34
- (163) MIGEOTTE, M., NEVEN, L. and SWENSON, J. (1957) Solar spectrum from 2.8 to 23.7 microns II, Data and identifications: Mem. Soc. Roy. Sci. Liege, No. 2, 30 pp
- (164) MILATZ, J.M.W., KLUYVER, J.C. and HARDEBOL, J. (1951) Determination of isotope ratios, e.g. in tracer work, by an infrared absorption method: J. Chem. Phys., v. 19, 887-888
- (165) MINNAERT, M.G.J. (1957) The determination of cosmic abundances: Monthly Notices Royal Astron. Soc., v. 117, 315

- (166) MITCHELL, J.J., PERKINS, R.H. and COLEMAN, F.F. (1948) Secondary processes of ion production in the mass spectrometer: *J. Chem. Phys.*, v. 16, 835-836
- (167) MOLES, E. (1938) The precision obtainable with the method of limiting densities: *Arch. Sci. Phys. Nat.*, v. 20, 59-65
- (168) NAKAI, N. (1960) Carbon isotope fractionation of natural gas in Japan: *J. Earth Sci.*, Nagoya Univ., v. 8, 174-180
- (169) NAKANE, R. and OHYAMA, T. (1963) Isotopic fractionation of carbon by molecular distillation: *Sci. Papers Inst. Phys. Chem. Res. (Tokyo)* v. 57, 7-9
- (170) NAUGHTON, J.J. and TERADA, K. (1954) Effect of eruption of Hawaiian volcanoes on the composition and carbon isotope content of associated volcanic and fumarolic gases: *Science*, v. 120, 580-581
- (171) NEVENZEL, J.C., HOWTON, D.R., RILEY, R.F. and STEINBERG, G. (1957) Bibliography of syntheses with carbon isotopes: U.S. Atomic Energy Comm. UCLA-395, 172 pp
- (172) NEVENZEL, J.C., RILEY, R.F., HOWTON, D.R. and STEINBERG, G. (1954) Bibliography of syntheses with carbon isotopes: U.S. Atomic Energy Comm. UCLA-316, 175 pp
- (173) NIER, A.O. (1950) A redetermination of the relative abundances of the isotopes of carbon, nitrogen, oxygen, argon and potassium: *Phys. Rev.*, v. 77, 789-793
- (174) NIER, A.O. (1953) Present status of isotope abundances: *Natl. Bur. Standards (U.S.) Circ.* 522, 131-132
- (175) NIER, A.O. and GULBRANSEN, E.A. (1939) Variations in the relative abundance of the carbon isotopes: *J. Amer. Chem. Soc.*, v. 61, 697
- (176) NORMAN, R.W.v. and BROWN, A.H. (1952) The relative rates of photosynthetic assimilation of isotopic forms of carbon dioxide: *Plant. Physiol.*, v. 27, 691-709

- (177) OANA, S. and DEEVEY, E.S. (1960) Carbon-13 in lake waters and its possible bearing on paleo-limnology: Amer. Jour. Science, v. 258A, 253-272
- (178) OLARIU, A. (1962) Optimal regime for total separation of the light isotopes (C^{13} , N^{15} and O^{18}) and stage arrangement of separation installations: Acad. Rep. Populare Romine, Studii Cercetari Fiz., v. 13, 933-938
- (179) PANCHENKO, V.G. (1951) Isotopes: Priroda, v. 39, 16-26
- (180) PANCHENKOV, G.M. and MOISEEV, V.D. (1956) Concentration of the carbon-13 and oxygen-18 isotopes in carbon monoxide by the methods of thermal diffusion: Zhur. Fiz. Khim., v. 30, 1662-1667.
- (181) PANCHENKOV, G.M., SEMIOKHIN, I.A., MAURINA, A.G. and ERSHOVA, N.P. (1956) Separation of carbon isotopes by countercurrent chemical exchange in the gas phase: Zhur. Fiz. Khim., v. 30, 2070-2076
- (182) PARK, R. and DUNNING, H.N. (1960) Stable carbon isotope studies of crude oils and their porphyrin aggregates: Bull. Geol. Soc. Amer., v. 71, 1942
- (183) PARK, R. and DUNNING, H.N. (1961) Stable carbon isotope studies of crude oils and their porphyrin aggregates: Geochim. et Cosmochim. Acta, v. 22, 99-105
- (184) PARK, R. and EPSTEIN, S. (1960) Carbon isotope fractionation during photosynthesis: Geochim. et Cosmochim. Acta, v. 21, 110-126
- (185) PARK, R.B. and EPSTEIN, S. (1961) Metabolic fractionation of C^{13} and C^{12} in plants: Plant Physiol., v. 36, 133-138
- (186) PARKER, P.L. (1962) Biogeochemistry of the stable isotopes of carbon in a marine bay: Geol. Soc. Amer. 1962 Ann. Meet. Preprints, 113A
- (187) PARWEL, A. (1954) The conversion of organic carbon to carbon dioxide and the preparation of barium carbonate for mass spectrometric determination: Deep-Sea Research, v. 1, 119-120

CARBON
18

- (188) PAULITSCH, P. and HAHN-WEINHEIMER, P. (1961) C¹² and C¹³ isotopes in metamorphites: Naturwissenschaften, v. 48, 597-598
- (189) PETROV, V.S. and NIKITIN, O.T. (1962) The composition of stable carbon isotopes in kimberlites: Vestn. Mosk. Univ. Ser. IV, Geol., v. 17, 51-53
- (190) PETROVSKAYA, N.V. and GRINENKO, L.N. (1962) The isotopic composition of the elements in relation to problems concerning the genesis of ore deposits: Geol. Rudn. Mestorozhd. No. 2, 3-31
- (191) PITZER, K.S. (1949) Carbon isotope effect on reaction rates: J. Chem. Phys., v. 17, 1341-1342
- (192) PROMISLOW, A.L. (1955) Relative isotope effects of carbon-13 and carbon-14: Dissertation Abstr., v. 15, 723
- (193) RABIDEAU, G.S. and BURR, G.O. (1945) Use of the C¹³ isotope as a tracer for transport studies in plants: Am. J. Botany, v. 32, 349-356
- (194) RANKAMA, K. (1948) New Evidence of the origin of pre-Cambrian carbon: Bull. Geol. Soc. Amer., v. 59, 389-416
- (195) RANKAMA, K. (1948) A note on the original isotopic composition of terrestrial carbon: J. Geol., v. 56, 199-209
- (196) RANKAMA, K. (1950) *Corycium resuscitatum*: A discussion: J. Geol., v. 58, 75-79
- (197) RANKAMA, K. (1954) What killed *Corycium enigmaticum*?: Econ. Geol., v. 49, 541-543
- (198) RANKAMA, K. (1954) Isotope Geology: McGraw-Hill (New York), 535 pp
- (199) RANKAMA, K. (1954) Early pre-Cambrian carbon of biogenic origin from the Canadian Shield: Science, v. 119, 506-507

- (200) RANKAMA, K. (1954) The isotopic constitution of carbon in ancient rocks as an indicator of its biogenic or nonbiogenic origin: *Geochimica et Cosmochimica Acta*, v. 5, 142-152
- (201) RANKAMA, K. (1954) Origin of carbon in some early Precambrian carbonaceous slates from southeastern Manitoba, Canada: *Bull. comm. geol. Finlande*, No. 166, 5-20
- (202) RANKAMA, K. (1958) Geochemical applications of radioactivity and of stable isotopes: *Cursillos y conf. Inst. "Lucas Mallada"*, v. 5, 3-15
- (203) RANKAMA, K. (1963) Progress in isotope geology: *Interscience* (New York) 705 pp
- (204) REID, A. and UREY, H.C. (1943) The use of the exchange between CO_2 , H_2CO_3 , HCO_3 ion and H_2O for isotopic concentration: *J. Chem. Phys.*, v. 11, 403-412
- (205) RIGHINI, G. (1957) The abundance of the carbon isotope carbon-13 in the sun: *Mem. Soc. Roy. Sci. Liege*, v. 18, 265
- (206) RIGHINI, G. (1963) Isotopes in the solar atmosphere: *Ric. Sci., Riv.*, v. 3, 145-156
- (207) ROONEY, L.F. (1956) Organic carbon in Phosphoria formation: *Bull. Amer. Assoc. Petrol. Geol.*, v. 40, 2267-2271
- (208) ROPP, G.A. (1952) Effect of isotope substitution on organic reaction rates: *Nucleonics*, v. 10, 22-27
- (209) ROSENFIELD, W.D. and SILVERMAN, S.R. (1959) Carbon isotope fractionation in bacterial production of methane: *Science*, v. 130, 1658-1659
- (210) ROSS, C.A. and OANA, S. (1961) Late Pennsylvanian and Early Permian limestone petrology and carbon isotope distribution, Glass Mountains, Texas: *J. Sed. Petrol.*, v. 31, 231-244
- (211) SACKETT, W.M. and THOMPSON, R.R. (1961) Stable carbon isotopes in organic material in Upper Gulf of Mexico and nearby continental sediments: *Geol. Soc. Amer. Spec. Publ.* v. 68, 258-259

- (212) SACKETT, W.M. and THOMPSON, R.R. (1963) Isotopic organic carbon composition of recent continental derived clastic sediments of eastern gulf coast, Gulf of Mexico: Bull. Amer. Assoc. Petrol. Geol., v. 47, 525-528
- (213) SAKATA, H., MATSUDA, K. and TAKEDA, E. (1953) Thermal concentration of carbon isotopes with carbon monoxide gas: J. Phys. Soc. Japan, v. 8, 313-317
- (214) SANFORD, R.F. (1929) Carbon isotopes in class N stars: Astron. Soc. Pacific, v. 41, 271
- (215) SANFORD, R.F. (1932) Further details ascribable to the bands of the carbon isotope C¹³ in stars of spectral classes R and N: Astron. Soc. Pacific, v. 44, 246
- (215) SANFORD, R.F. (1940) Carbon isotope bands in stars of spectral class R: Astron. Soc. Pacific, v. 52, 203-205
- (216) SCHOPP, J.D. (1954) Determination of the upper limits to the abundance of carbon 13 in normal red giant stars: Astron. J., v. 59, 192-193
- (217) SCHOPP, J.D. (1961) Determination of lower limits to the abundance ratio of carbon-12 to carbon-13 in the atmospheres of G8 to K5 giant stars: Dissertation abstracts, v. 21, 2858
- (218) SCHUTTEN, J., BOERBOOM, A.J.H., HAUW, T. and MONTERIE, F. (1957) Precise measurement of isotope ratios with a single collector mass spectrometer: Appl. Sci. Research, v. 6B, 388-392
- (219) SEMIOKHIN, I.A., ANDREEV, YU.P. and PANCHENKOV, G.M. (1963) Separation of O and C isotopes in dissociation of CO₂ in the silent electric discharge: Zh. Fiz. Khim., v. 37, 2782-2783
- (220) SEMIOKHIN, I.A., PANCHENKOV, G.M. and ERSHOVA, N.P. (1963) The separation of carbon isotopes by countercurrent chemical exchange in the gas phase II. Effect of N and O: Zh. Fiz. Khim., v. 37, 1409-1411

- (221) SEMIOKHIN, I.A., PANCHENKOV, G.M. and ZHUROV, YU.A. (1959) Use of isotope exchange between carbon dioxide and the carbonate ion to separate the isotopes of carbon and oxygen: *Zhur. Fiz. Khim.*, v. 33, 2633-2635
- (222) SHAIN, G.A. and GAZE, V.F. (1951) Ratio of the concentration of the isotopes of carbon-13 and carbon-12 in stellar atmospheres: *Uspekhi Fiz. Nauk*, v. 43, 3-10
- (223) SHAIN, G.A. and GAZE, V.F. (1952) Isotopes in stars: *Pamyati Sergeya Ivanovicha Vavilova, Akad. Nauk U.S.S.R.*, 157-171
- (224) SHAIN, G.A. and GAZE, V.F. (1954) The isotope C¹³ in stellar spectra: Processus nucleaires dans astres. 5^e Colloque intern. astrophys., Liege, Sept. 1953, in *Mem. Soc. Roy. Sci. Liege*, v. 14, 397-401
- (225) SHAIN, G.A. and SEVERNYI, A.B. (1941) Isotopes of carbon molecules in the atmospheres of N class stars: *Astron. Zhur.*, v. 18, 165-167
- (226) SILVERMAN, S.R. (1961) Evidence for an age effect in the carbon isotopic composition of natural organic materials: *Geol. Soc. Amer. Spec. Publ.* 68, 272
- (227) SILVERMAN, S.R. (1962) Effect of evolution of land plants on C¹³/C¹² ratios of natural organic materials: *J. Geophys. Research*, v. 67, 1657
- (228) SILVERMAN, S.R. (1964) Carbon isotope geochemistry of petroleum: 1st Joint Intern. Meet. Amer. Assoc. Petrol. Geol., Soc. Econ. Pal. Min., Geol. Soc. Can., Mineral. Assoc. Can. 1964 Meet. Preprints, 547
- (229) SILVERMAN, S.R. (1964) Investigations of petroleum origin and evolution mechanisms by carbon isotope studies: in, *Cosmic and Isotopic chemistry*: ed. by H. Craig, S.L. Miller and G.J. Wasserburg North Holland (Amsterdam) 92-102
- (230) SILVERMAN, S.R. and EPSTEIN, S. (1954) Isotopic composition of carbon in petroleum and other organic constituents of sediments: *Bull. Geol. Soc. Amer.*, v. 65, 1305

- (231) SILVERMAN, S.R. and EPSTEIN, S. (1958) Carbon isotopic compositions of petroleums and other sedimentary organic materials: Bull. Amer. Assoc. Petrol. Geol., v. 42, 998-1012
- (232) SINTON, W.M. (1962) Infrared observations of Venus: Mem. Soc. Roy. Sci. Liege, v. 7, 300-310
- (233) SLACK, H.A. (1962) Geochemical Oil Exploration: U.S. Patent 3,033,654
- (234) SOUTHERN, A.L., MORGAN, H.W., KEILHOLTZ, G.W. and SMITH, W.V. (1951) Isotopic determination of nitrogen and carbon by a microwave spectrograph: Anal. Chem., v. 23, 1000-1004
- (235) SPITZER, E.J. and SITES, J.R. (1963) Isotopic mass spectrometry of the elements: U.S. Atomic Energy Comm. ORNL-3528, 81 pp
- (236) STUIVER, M. (1964) Carbon isotopic distribution and correlated chronology of Searles lake sediments: Am. J. Science, v. 262, 377-392
- (237) STUKE, B. (1953) Procedure of chemical isotope exchange: Z. Elektrochem., v. 57, 655-659
- (238) SUÈSS, H.E. (1960) Carbon isotope ratios in Pacific ocean water: J. Geophys. Research, v. 65, 2526-2527
- (239) TAYLOR, T.I. and BERNSTEIN, R.B. (1947) Enrichment of C¹³ and O¹⁸ by a countercurrent gaseous exchange process using thermal diffusion: J. Am. Chem. Soc., v. 69, 2076
- (240) THODE, H.G., WANLESS, R.K. and WALLOUCH, R. (1953) Origin of Texas and Louisiana sulfur deposits from isotope fractionation studies: Proc. Conf. Nuclear Processes in Geol. Settings, Univ. Chicago, Natl. Research Council, Natl. Sci. Foundation, 1953, 57-63
- (241) THODE, H.G., WANLESS, R.K. and WALLOUCH, R. (1954) The origin of native sulfur deposits from isotope fractionation studies: Geochimica et Cosmochimica Acta, v. 5, 286-298

- (242) THUGUTT, S.J. (1949) The beginning of life and carbon isotopes: Wiadomosci Muzeum Ziemi, v. 4, 60-64
- (243) TIKHOMIROV, M.V. and TUNITSKII, N.N. (1959) Separation of carbon and oxygen isotopes by rectification of carbon monoxide in a 12-meter column: Zhur. Priklad. Khim., v. 32, 531-536
- (244) TROFIMOV, A.V. (1950) Ratio of the carbon isotopes in meteorites: Doklady Akad. Nauk U.S.S.R., v. 72, 663-666
- (245) TROFIMOV, A.V. (1952) Isotopic composition of carbon of magmatic minerals: Doklady Akad. Nauk U.S.S.R., v. 85, 169-172
- (246) TUNITSKII, N.N., DEVYATYKH, G.G., PETROV, P.S., and TORLIN, B.Z. (1958) Separation of the carbon isotopes by thermal diffusion of carbon monoxide: Soviet Phys.-Tech. Phys., v. 3, 822-826
- (247) TUNITSKII, N.N., DEVYATYKH, G.G., TIKHOMIROV, M.V., ZORIN, A.D., and NIKOLAEV, N.I. (1957) The separation of carbon isotopes: Proc. All-Union Sci. Tech. Conf. Appl. Radioactive Isotopes, Moscow 1957, 141-148
- (248) UBBELOHDE, A.R. (1948) The freezing-in of nuclear equilibrium: Proc. Phys. Soc. (London), v. 61, 96-97
- (249) UBISCH, H.v. (1949) The Mass spectrometer and its use I: Fra Fysik. Verden, No. 3, 170-178 (1949) II: Ibid. No. 4, 229-241
- (250) UREY, H.C. (1947) Thermodynamic properties of isotopic substances: J. Chem. Soc., 562-581
- (251) UREY, H.C. and GREIFF, L.J. (1935) Isotopic exchange equilibria: J. Am. Chem. Soc., v. 57, 321-327
- (252) VAUGHAN, A.L., WILLIAMS, J.H. and TATE, J.T. (1934) Isotopic abundance ratios of carbon, nitrogen, argon, neon and helium: Phys. Rev., v. 45, 327
- (253) VEDDER, R. (1960) Isotope analysis in geological samples for O¹⁸ and C¹³: Kernenergie, v. 3, 890-892

- (254) VINOGRADOV, A.P. (1954) Geochemistry of isotopes: Vestnik Akad. Nauk U.S.S.R., v. 24, 26-43
- (255) VINOGRADOV, A.P. (1959) Geochemistry of isotopes: Internat. Geol. Rev., v. 1, 1-13
- (256) VINOGRADOV, A.P., GRINENKO, V.A. and USTINOV, V.I. (1961) Origin of the Carpathian sulfur deposits from S^{32}/S^{34} and C^{12}/C^{13} ratios: Geokhimiya, 827-836
- (257) VOGEL, J.C. (1959) Isotopic composition of carbon in freshwater calcareous deposits: Geochim. et Cosmochim. Acta, v. 16, 236-242
- (258) VUL'FSON, V.I. (1957) Use of radioactive atoms in hydrometeorological and hydrochemical investigations: Vysshee Inzh. Morskoe Uchilische. No. 6, 9-18
- (259) WANG, C. (1963) Separation of stable isotopes: Hua Hsueh Tung Pao, No. 8, 458-468
- (260) WEBER, J.N., BERGENBACK, R.E., WILLIAMS, E.G. and KEITH, M.L. (1964) Reconstruction of depositional environments in the Pennsylvanian Vanport Basin by carbon isotope ratios: J. Sed. Petrol., in press
- (261) WEBER, J.N. and KEITH, M.L. (1962) Isotopic composition and environmental classification of selected limestones and fossils: Geol. Soc. Amer. Meet. Preprints, 159A-160A
- (262) WEBER, J.N. and KEITH, M.L. (1962) Carbon isotopic composition and the origin of calcareous coal balls: Science, v. 138, 900-902
- (263) WEBER, J.N., WILLIAMS, E.G. and KEITH, M.L. (1964) Paleoenvironmental significance of carbon isotopic composition of siderite nodules in some shales of Pennsylvania age: J. Sed. Petrol., in press
- (264) WEST, S.S. (1945) Relative abundance of the carbon isotopes in petroleum: Geophysics, v. 10, 406-420

- (265) WHITE, D.E. and CRAIG, H. (1959) Isotope geology of the Steamboat Springs area, Nevada: Bull. Geol. Soc. Amer., v. 70, 1696
- (266) WICKMAN, F.E. (1952) Variations in the relative abundance of the carbon isotopes in plants: *Geochimica et Cosmochimica Acta*, v. 2, 243-254
- (267) WICKMAN, F.E. (1952) Variations in the relative abundance of the carbon isotopes in plants: *Nature*, v. 169, 1051
- (268) WICKMAN, F.E. (1953) Was the isotopic constitution of carbon changed by coalification?: *Geochimica et Cosmochimica Acta*, v. 3, 244-252
- (269) WICKMAN, F.E. (1956) The cycle of carbon and the stable carbon isotopes: *Geochimica et Cosmochimica Acta*, v. 9, 136-153
- (270) WICKMAN, F.E., BLIX, R. and UBISCH, H.v. (1951) The variation in the relative abundance of the carbon isotopes in carbonate minerals: *J. Geol.*, v. 59, 142-150
- (271) WICKMAN, F.E. and UBISCH, H.v. (1951) Two notes on the isotopic constitution of carbon in minerals: *Geochimica et Cosmochimica Acta*, v. 1, 119-122
- (272) WILLIAMS, M. (1961) Stable isotope studies in solution of geologic problems: *Bull. Amer. Assoc. Petrol. Geol.*, v. 45, 407
- (273) WILSON, A.T., GUMBLEY, J.M. and SPEDDING, D.J. (1963) Resin metabolism in the sapwood of *Pinus radiata*: *Nature*, v. 198, 500
- (274) WILSON, O.C. (1948) A preliminary lower limit to the ratio C^{12}/C^{13} in interstellar matter: *Astron. Soc. Pacific*, v. 60, 198-200
- (275) WOOD, H.G. (1950) Carbon dioxide fixation in biochemistry: Brookhaven Conf. Rept., Carbon Dioxide Assimilation Reactions in Biol. Systems, BNL-70, 1-15
- (276) WOOD, H.G. and HARRIS, D.L. (1952) A study of carbon dioxide fixation by mass determination of the types of carbon-13 acetate: *J. Biol. Chem.*, v. 194, 905-931

- (277) WOOLDRIDGE, D.E. and JENKINS, F.A. (1936) The enrichment of carbon in the heavier isotope by diffusion: Phys. Rev., v. 49, 404
- (278) YAGODIN, G.A., UVAROV, O.V. and ZHAVORONKOV, N.M. (1956) Carbon isotope partition coefficient in the liquid-vapor equilibrium of ethylene, ethane and methane: Doklady Akad. Nauk U.S.S.R., v. 111, 384-387
- (279) YANKWICH, P.E. (1948) Isotope effects in some simple chemical processes: Brookhaven Conf. Rept., Isotopic exchange and chem. kinetics, Chem. kinetics, Chem. Conf. #2, 44-52
- (280) YANKWICH, P.E. and CALVIN, M. (1949) An effect of isotopic mass on the rate of a reaction involving the carbon-carbon bond: J. Chem. Phys., v. 17, 109-110
- (281) YEH, Ming-Han and CHENG-WU Li (1958) Application of gamma rays excited by heavy charged particles in the determination of isotopic abundances: Wu Li Hsueh Pao, v. 14, 64-70
- (282) ZHAVORONKOV, N.M., BABKOV, S.I. and UVAROV, O.V. (1958) Concentration of stable isotopes by a method of fractional distillation and isotopic chemical exchange: Collection Czechoslov. Chem. Communns., v. 23, 1727 - 1734

OXYGEN

27

- (1) ADAMSON, A.W. and IRANI, R.R. (1957) Diffusion of oxygen-18 and of protium in D_2O-H_2O mixtures: J. Am. Chem. Soc., v. 79, 2967-2968
- (2) ADEL'BERG, I.M. and DVALI, M.F. (1961) The geochemical examination of petroleum by isotope analysis: Tr. Vses. Neft. Nauchn.-Issled. Geologorazved. Inst. No. 174, 186-198
- (3) ALBERTY, R.A. and MILLER, G.W. (1957) Integrated rate equations for isotopic exchange in simple reversible reactions: J. Chem. Phys., v. 26, 1231-1237
- (4) ALEXANDER, O.R. and HALL, N.F. (1940) Measurement of the excess weight of air oxygen by exchange with inorganic salts: J. Am. Chem. Soc., v. 62, 3462-3464
- (5) ALEXANDER, W.A. and MUNRO, L.A. (1936) Note on isotopes in snow and rain: Can. J. Research, v. 14B, 47
- (6) ALLEGRE, C., BOULANGER, D. and JAVOY, M. (1963) Paleothermometry of Basque nummulites with the aid of oxygen isotopes: Compt. Rend. Soc. Geol. France, 256-258
- (7) ALLEN, J.A. and LAUDER, I. (1949) Oxygen exchange with oxides: Nature, v. 164, 142-143
- (8) ANBAR, M. and GUTTMAN, S. (1959) Isotopic analysis of oxygen in inorganic compounds: Intern. J. Appl. Radiation and Isotopes, v. 5, 233-235
- (9) ANCONA, E., BOATO, G. and CASANOVA, G. (1962) Vapor pressure of isotopic liquids IV, CO, N, O above the boiling point: Nuovo Cimento, v. 24, 111-121
- (10) ANDREEV, YU.P., SEMIOKHIN, I.A. and PANCHENKOV, G.M. (1964) A study of the redistribution of oxygen and carbon isotopes between carbon dioxide and the products of its dissociation in the silent electrical discharge: Zh. Fiz. Khim., v. 38, 1032-1034
- (11) APRILE, G. (1955) Isotopic methods in geological and geomineralogical investigations: Riv. Mineraria Siciliana, v. 6, 9-13

OXYGEN
28

- (12) ARRHENIUS, G., KJELLBERG, G. and LIBBY, W.F. (1951)
Age determinations of Pacific chalk ooze by
radiocarbon and titanium content: Tellus, v. 3,
222-229
- (13) ASIMOV, I. (1955) The composition of the atmosphere:
J. Chem. Education, v. 32, 633-634
- (14) ASTON, F.W. (1929) The constitution of oxygen: Nature,
v. 123, 488-489
- (15) AUJESZKY, L. (1949) Isotopes in the atmosphere: Időjarás,
v. 53, 289-292
- (16) AUMANN, D.C. and BORN, H.J. (1964) Determination of the
 O_{18} content of water by neutron irradiation:
Naturwissenschaften, v. 51, 159
- (17) AZCONA, J.M.L. d. (1955) Natural isotopic variations of
the chemical elements: Rev. cienc. apl.
(Madrid), v. 9, 193-207
- (18) BABCOCK, H.D. (1929) The constitution of oxygen: Nature,
v. 123, 761
- (19) BABCOCK, H.D. (1929) Some new features of the atmospheric
oxygen bands and the relative abundance of the
isotopes O_{16}/O_{18} : Proc. Natl. Acad. Sci., U.S.,
v. 15, 471-477
- (20) BAERTSCHI, P. (1950) Isotopic composition of the oxygen
in silicate rocks: Nature, v. 166, 112-113
- (21) BAERTSCHI, P. (1950) Distribution of oxygen isotopes in
the lithosphere: Helv. Phys. Acta, v. 23,
536-537
- (22) BAERTSCHI, P. (1951) Relative abundances of oxygen and
carbon isotopes in carbonate rocks: Nature, v. 168,
288-289
- (23) BAERTSCHI, P. (1953) The relative difference in H_2O^{18} content
of natural water: Helv. Chim. Acta, v. 36,
1352-1369

- (24) BAERTSCHI, P. (1957) Measurement and interpretation of the relative variations of abundance of oxygen-18 and carbon-13 in carbonate rocks and minerals: Schweiz. mineral. petrog. Mitt., v. 37, 73-152
- (25) BAERTSCHI, P. and SCHWANDER, H. (1952) A new method for measuring differences in oxygen-18 content of silicate rocks: Helv. Chim. Acta., v. 35, 1748-1751
- (26) BAERTSCHI, P. and SILVERMAN, S.R. (1951) The determination of relative abundances of the oxygen isotopes in silicate rocks: Geochimica et Cosmochimica Acta, v. 1, 317-328
- (27) BAERTSCHI, P. and THÜRKAUF, M. (1960) Isotope effect for the separation of O isotopes O^{16} and O^{18} by the rectification of H_2O and D_2O : Helv. Chim. Acta, v. 43, 80-89
- (28) BECKER, E.W. and VOGELL, W. (1950) The natural distribution of carbon-13 and oxygen-18 and the redistribution of the isotopes in the solution equilibrium: hydrocyanic acid-glacial acetic acid: Z. Naturforsch., v. 5a, 174-175
- (29) BEGUN, G.M. and ALLEN, R.E. (1954) Isotope separation and isotope exchange, a bibliography of unclassified literature: Rept. No. TID-3036, U.S. Atomic Energy Comm., 122 pp
- (30) BENDER, M.L., STONE, R.R. and DEWEY, R.S. (1956) Kinetics of isotopic oxygen exchange between substituted benzoic acids and water: Jour. Amer. Chem. Soc., v. 78, 319-321
- (31) BENEDICT, W.S. (1957) Identification of H_2O^{18} and H_2O^{17} telluric lines in the infra-red solar spectrum: Mem. Soc. Roy. Sci. Liege, v. 18, 557-571
- (32) BENTLEY, R. (1948) Oxygen-18 as a tracer element: Nucleonics, v. 2, 18-30
- (33) BENTLEY, R. (1948) The use of oxygen-18 isotope: Cold Spring Harbor Quant. Biol., v. 13, 11-21

OXYGEN
30

- (34) BENTLEY, R. (1949) Apparatus for microelectrolysis of water: Biochem. J., v. 45, 591-592
- (35) BERNEY, C. V. and EGGERS, D. F., Jr. (1964) Infrared spectrum of carbon dioxide enriched in oxygen-18: J. Chem. Phys., v. 40, 990-1000
- (36) BIGELEISEN, J. (1952) Isotopes: Ann. Rev. Phys. Chem., v. 3, 39-56
- (37) BIGELEISEN, J. The effect of isotopic substitution on the rates of chemical reactions: J. Phys. Chem., v. 56, 823-828
- (38) BIGELEISEN, J. (1953) Isotopes: Ann. Rev. Nuclear Sci., v. 2, 221-238
- (39) BIGELEISEN, J. (1960) Vapor pressures and related thermodynamic properties of the isotopic nitric oxide molecules: J. Chem. Phys., v. 33, 1775-1777
- (40) BIGELEISEN, J. (1964) Isotope effects in phase equilibria: A new tool for the study of intermolecular forces: J. Chim. Phys., 87-91
- (41) BIGELEISEN, J. and RIBNIKAR, S. V. (1961) Structural effects in the vapor pressures of isotopic molecules: O₁₈ and N¹⁵ substitution in N₂O: J. Chem. Phys., v. 35, 1297-1305
- (42) BIRGE, R. T. (1929) Isotopes of oxygen: Nature, v. 124, 13-14
- (43) BIRGE, R. T. and MENZEL, D. H. (1931) Relative abundance of the oxygen isotopes and the basis of the atomic weight system: Phys. Rev., v. 37, 1669-1671
- (44) BLEAKNEY, W. and HIPPLE, J. A., Jr. (1935) Oxygen isotopes: Phys. Rev., v. 47, 800
- (45) BOATO, G. and CASANOVA, G. (1964) Separation factor in isotope phase equilibria, in, Isotopic and Cosmic Chemistry, ed. by H. Craig, S. L. Miller and G. J. Wasserburg, North Holland (Amsterdam) 16-33

- (46) BOATO, G. CASANOVA, G. and LEVI, A. (1962) Isotope effect in phase equilibria: *J. Chem. Phys.*, v. 37, 201
- (47) BOATO, G. SCOLES, G. and VALLAURI, M. E. (1959) Vapor pressure of isotopic liquids, I. Ar, B, O below the boiling point: *Nuovo Cimento*, v. 14, 735-747
- (48) BONNER, F. and BIGELEISEN, J. (1952) Non-exchange of oxygen between water and some compounds of nitrogen: *J. Am. Chem. Soc.*, v. 74, 4944-4945
- (49) BOREK, E. and RITTENBERG, D. (1960) Anomalous growth of microorganisms produced by changes in isotopes in their environment: *Proc. Natl. Acad. Sci. U.S.*, v. 46, 777-782
- (50) BOWEN, R. (1961) Paleotemperature analyses of Mesozoic Belemnoidea from Germany and Poland: *J. Geol.*, v. 69, 75-83
- (51) BOWEN, R. (1961) Paleotemperature analyses of Belemnoidea and Jurassic paleoclimatology: *Jour. Geology*, v. 69, 309-320
- (52) BOWEN, R. (1961) Oxygen isotope paleotemperature measurements on Cretaceous Belemnoidea from Europe, India and Japan, *J. Paleo.*, v. 35, 1077-1084
- (53) BOWEN, R. (1961) Paleotemperature analyses of Mesozoic Belemnoidea from Australia and New Guinea: *Bull. Geol. Soc. Amer.*, v. 72, 769-774
- (54) BOWEN, R. (1964) Oxygen isotope paleotemperature measurements on Mesozoic Belemnoidea and their importance in paleoclimatic studies, in, *Advances in organic geochemistry*, ed. by U. Colombo and G. D. Hobson, Pergamon (New York)
- (55) BOYD, W. T. (1952) The concentration of oxygen 18 by chemical exchange: *Dissertation Abstracts*, v. 12, 458-459

OXYGEN

32

- (56) BOYD, W. T. and WHITE, R. R. (1952) Concentration of oxygen-18 by chemical exchange: Ind. Eng. Chem., v. 44, 2202-2207
- (57) BRADLEY, D. C. (1954) Fractionation of isotopes by distillation of some organic substances: Nature, v. 173, 260-261
- (58) BRANDNER, J. D. and UREY, H. C. (1945) Kinetics of the isotopic exchange reaction between carbon monoxide and carbon dioxide: J. Chem. Phys., v. 13, 351-362
- (59) BRODSKII, A. I. (1937) Isotopes of oxygen: Uspekhi Khim., v. 6, 152-177
- (60) BRODSKII, A. I. (1938) Stable isotopes of the light elements: Uspekhi Fiz. Nauk, v. 20, 153-196
- (61) BRODSKII, A. I. (1941) Heavy isotopes of hydrogen and oxygen: Sbornik Trudov I. V. Stalina Akad. Nauk U.S.S.R., 455-462
- (62) BRODSKII, A. I. (1952) Chemistry of isotopes: Izdatel 'stvo Akad. Nauk U.S.S.R., 352
- (63) BRODSKII, A. I. (1955) Dependence of isotopic exchange of hydrogen and oxygen in solutions on the structure of molecules: Akad. Nauk U.S.S.R. Otdel Khim. Nauk, 18-23
- (64) BRODSKII, A. I. ALEXHSANDROVICH, V. A. and SKARRE, O. K. (1937) Fractionation of isotopes in the distillation of water: Zhur. Fiz. Khim., v. 10, 538-539
- (65) BRODSKII, A. I., DEMIDENKO, S. G., STRIZHAK, L. L. and LECHEKHLEB, V. R. (1955) Rapid mass spectrometric micromethod for oxygen isotope analysis in water: Zhur. Anal. Khim., v. 10, 256-261
- (66) BRODSKII, A. I. and DONTSOVA, E. I. (1940) Exchange between oxygen isotopes in inorganic solvents: Dopovidi Akad. Nauk S.S.S.R., 3-7

OXYGEN

33

- (67) BRODSKII, A. I. and LUNENOK-BURMAKINA, V. A. (1955) Oxygen interchange between calcium carbonate and water in connection with the geologic thermometer: Doklady Akad. Nauk U.S.S.R., v. 101, 715-717
- (68) BRODSKII, A. I. and RADCHENKO, N. P. (1940) Isotopic composition of arctic seas and ices: Acta Physicochim. U.S.S.R., v. 13, 145-156
- (69) BRODSKII, A. I., RADCHENKO, N. P. and SMOLENSKAYA, B. L. (1939) Isotopic composition of artic waters, ices and glaciers: J. Phys. Chem. (U.S.S.R.), v. 13, 1494-1501
- (70) BRODSKII, A. I. and SKARRE, O. K. (1939) Concentration of the heavy oxygen isotope by distillation of water and the isotopic analysis of water: Acta Physicochim., U.S.S.R., v. 10, 729-752
- (71) BRODSKII, A. I. and SKARRE, O. K. (1939) Concentration of heavy oxygen isotope by redistillation of water and the isotopic analysis of water: Zhur. Fiz. Khim., v. 13, 451-463
- (72) BRODSKII, A. I., SKARRE, O. K. and ALEKSANDROVICH, V. A. (1937) Fractionation of oxygen isotopes in the distillation of water: Acta Physicochim. U.S.S.R., v. 7, 469-472
- (73) BRODSKII, A. I., SKARRE, O. K., DONTSOVA, E. I. and SLUTZKAYA, M. M. (1937) Isotope composition of snow and mountain water: Acta Physicochim. U.S.S.R., v. 7, 611-620
- (74) BROWN, A. H. (1953) The effects of light on respiration using isotopically enriched oxygen: Am. J. Botany, v. 40, 719-729
- (75) BROWN, A. H. and WEBSTER, G. C. (1953) Influence of light on the rate of respiration of the blue-green alga, Anabaena: Am. J. Botany, v. 40, 753-758
- (76) BROWN, J. B. (1957) Determination of oxygen isotope ratios by density measurements: J. Sci. Labs. Denison Univ., v. 44, 96-105

OXYGEN

34

- (77) BROWN, L. and DRURY, J. S. (1959) Fractionation of oxygen isotopes between water and sulfur dioxide: *J. Phys. Chem.*, v. 63, 1885-1886
- (78) BROWNLLOW, A. H. (1957) The oxygen isotope thermometer: a critical review: *Trans. Amer. Geophys. Union.*, v. 38, 388-389
- (79) BROWNLLOW, A. H. (1957) Continued investigations of theoretical aspects of isotopic exchange equilibria: The carbonate-water thermometer: Fourth Ann. Progress Report for 1956-57, U.S. Atomic Energy Commission, 85-117
- (80) BUCHSBAUM, R. (1957) Paleoecological factors in the sea: *Annee biol.*, v. 33, 283-285
- (81) BUNTON, C. A., HALEVI, E. A. and LLEWELLYN, D. R. (1953) Oxygen exchange between nitric acid and water III. Catalysis by nitrous acid: *J. Chem. Soc.*, 2653-2657
- (82) BUNTON, C. A. and LLEWELLYN, D. R. (1952) Decomposition of hydrogen peroxide in water enriched in heavy oxygen: *Research (London)*, v. 5, 142-143
- (83) BURBIDGE, G. R. (1960) A revised table of abundances of elements by A. G. W. Cameron: *Astrophys. J.*, v. 131, 519-521
- (84) CAHILL, A. E. and TAUBE, H. (1952) Use of heavy oxygen in the study of reactions of hydrogen peroxide: *J. Am. Chem. Soc.*, v. 74, 2312-2318
- (85) CAMERON, A. G. W. (1959) A revised table of abundances of the elements: *Astrophys. J.*, v. 129, 676-699
- (86) CAMERON, W. C., FARKAS, A. and LITZ, L. M. (1953) Exchange of isotopic oxygen among vanadium pentoxide, gaseous oxygen and water: *J. Phys. Chem.*, v. 57, 229-238
- (87) CHENG, C. H. (1963) Uses of stable isotopes: *Hua Hsueh Tung Pao*, No. 9, 550-555

OXYGEN
35

- (88) CHILINGAR, G. V. (1955) Is $O^{18}:O^{16}$ ratio in carbonate rocks an accurate geologic thermometer? Brief review of Russian literature: Bull. Amer. Assoc. Petrol. Geol., v. 39, 2349-2350
- (89) CHRIST, R. H., MURPHY, G. M. and UREY, H. C. (1933) Isotopic analysis of water: J. Am. Chem. Soc., v. 55, 5060-5061
- (90) CLAYTON, R. N. (1958) Stable isotopes in nature: Mineral Industries, v. 27, 1-5.
- (91) CLAYTON, R. N. (1959) Oxygen isotope fractionation in the system calcium carbonate-water: J. Chem. Phys., v. 30, 1246-1250
- (92) CLAYTON, R. N. (1961) Equilibrium constants for oxygen-isotope exchange in mineral systems: Amer. Geophys. Union. 1961 1st Western Nat. Meet. Preprints, p. 41
- (93) CLAYTON, R. N. (1961) Oxygen isotope fractionation between calcium carbonate and water: J. Chem. Phys., v. 34, 724
- (94) CLAYTON, R. N. (1963) Oxygen isotope geochemistry: thermometry of metamorphic rocks, in, Studies in Analytical Geochemistry, ed. by D. M. Shaw, Roy. Soc. Canada Spec. Publ. #6, 42-57
- (95) CLAYTON, R. N. (1963) High temperature isotopic thermometry: Natl. Acad. Sci.-Natl. Res. Council Publ. 1075, 185-195
- (96) CLAYTON, R. N. and EPSTEIN, S. (1958) The relationship between O^{18}/O^{16} ratios in coexisting quartz, carbonate and iron oxides from various geological deposits: J. Geology, v. 66, 352-371
- (97) CLAYTON, R. N. and EPSTEIN, S. (1961) The use of oxygen isotopes in high-temperature geological thermometry: J. Geology, v. 69, 447-452
- (98) CLAYTON, R. N. and MAYEDA, T. K. (1963) The use of bromine pentafluoride in the extraction of oxygen from oxides and silicates for isotopic analysis: Geochimica et Cosmochimica Acta, v. 27, 43-52

OXYGEN
36

- (99) CLUSIUS, K., DICKEL, G. and BECKER, E. (1943) Pure oxygen isotope O_2^{18} and nitrogen isotope $N^{14}N^{15}$: Naturwissenschaften, v. 31, 210
- (100) CLUSIUS, K., ENDTINGER, F. and SCHLEICH, K. (1961) Results of low-temperature research XXXIII, Vapor Pressure difference of O_2^{16} and O_2^{18} between 63 and 90°K: Helv. Chim. Acta, v. 44, 98-105
- (101) CLUSIUS, K. and SCHLEICH, K. (1958) Vapor pressure measurements of isotopic gases: Proc. U.N. Intern. Conf. Peaceful Uses of Atomic Energy, 2nd, Geneva, v. 4, 485-490
- (102) CLUSIUS, K. and SCHLEICH, K. (1958) Low temperature research XX. Direct comparison of vapor pressures of N_2^{14} , $N^{14}N^{15}$, N_2^{15} , $N^{14}O^{16}$, $N^{15}O^{16}$, and $N^{14}O^{18}$ between their melting and boiling points: Helv. Chim. Acta, v. 41, 1342-1358
- (103) CLUSIUS, K. and SCHLEICH, K. (1962) Separation Tube XXIV. Preparation of O_2^{18} and the problem of enrichment of O^{17} : Helv. Chim. Acta, v. 45, 1702-1721
- (104) CLUSIUS, K. SCHLEICH, K., ENDTINGER, F., BERNSTEIN, R. and VOGELMANN, M. (1963) Relation of the vapor pressures in the systems $C^{12}H_4/C^{13}H_4/C^{12}H_3D$; $N^{14}_2O/N^{15}N^{14}O$; SO^{16}_2/SO^{18}_2 ; and Ar^{36}/Ar^{40} : J. Chim. Phys., v. 60, 66-69
- (105) CLUSIUS, K., SCHLEICH, K. PIESBERGEN, U. and VARDE, E. (1963) Simultaneous concentration of the heavy isotopes of O and N by distillation of nitric oxide at low temperatures: J. Chim. Phys., v. 60, 48-51
- (106) COHN, M. (1964) Application of O^{18} to biochemical studies, in, Cosmic and Isotopic Chemistry, ed. by H. Craig, S. L. Miller and G. J. Wasserburg, North Holland (Amsterdam) 45-59
- (107) COMPSTON, W. and EPSTEIN, S. (1958) A method for the preparation of carbon dioxide from water vapor for oxygen isotope analysis: Trans. Amer. Geophys. Union, v. 39, 511-512

OXYGEN

37

- (108) COX, J. D. (1951) Synthesis of isotopic compounds for use in biological and chemical research: Chemist and Druggist, v. 156, 627-630
- (109) CRABLE, G. F. and KERR, N. F. (1957) Reaction of oxygen in a mass spectrometer to form carbon monoxide: Anal. Chem., v. 29, 1281-1282
- (110) CRAIG, H. (1953) Isotopic geochemistry of hot springs: Bull. Geol. Soc. Amer., v. 64, 1410
- (111) CRAIG, H. (1957) Isotopic tracer techniques for measurement of physical processes in the sea and the atmosphere: Natl. Research Council Publ. #551, 103-120
- (112) CRAIG, H. (1957) Isotopic standards for carbon and oxygen and correction factors for mass spectrometric analysis of carbon dioxide: Geochimica et Cosmochimica Acta, v. 12, 133-149
- (113) CRAIG, H. (1961) Isotopic variations in meteoritic waters: Science, v. 133, 1702-1703
- (114) CRAIG, H. (1961) Standard for reporting concentrations of deuterium and oxygen-18 in natural waters: Science, v. 133, 1833-1834
- (115) CRAIG, H. and BOATO, G. (1955) Isotopes: Ann. Rev. Phys. Chem., v. 6, 403-432
- (116) CRAIG, H., BOATO, G. and WHITE, D. E. (1954) Isotopic geochemistry of thermal waters: Bull. Geol. Soc. Amer., v. 65, 1243
- (117) CRAIG, H., BOATO, G. and WHITE, D. E. (1956) Isotopic geochemistry of thermal waters: Natl. Acad. Sci.-Natl. Research Council Publ. #400, 29-38
- (118) CRAIG, H., MAYEDA, T. and SUESS, H. E. (1958) Isotope composition of water from Neusiedler Lake near Vienna: Monatsh. v. 89, 173-174
- (119) DAHN, H. (1960) Oxygen isotopes in organic chemistry: Bull. Soc. Chim. France, 1875-1880

OXYGEN

38

- (120) DANSGAARD, W. (1953) The abundance of O^{18} in atmospheric water and water vapor: Tellus, v. 5, 461-469
- (121) DANSGAARD, W. (1954) O^{18} abundance in freshwater: Nature, v. 174, 234-235
- (122) DANSGAARD, W. (1954) The O^{18} abundance in freshwater: Geochimica et Cosmochimica Acta, v. 6, 241-260
- (123) DANSGAARD, W. (1958) Some meteorological and glaciological problems illustrated by measurement of the stable oxygen isotopes in water: Fysisk Tidsskrift, 49-65
- (124) DANSGAARD, W. (1960) The content of heavy oxygen isotope in the water masses of the Philippine Trench: Deep-Sea Research, v. 6, 346-350
- (125) DANSGAARD, W. (1961) The isotopic composition of natural waters, with special reference to the Greenland Ice Cap: Medd. Groenland, v. 165, 1-120
- (126) DANSGAARD, W., NIEF, G. and ROTH, E. (1960) Isotopic distribution in a Greenland iceberg: Nature, 185, 232
- (127) DATTNER, J. and FISCHLER, J. (1963) Calculations of oxygen isotope abundance ratios in a mass spectrometer: Brit. J. Appl. Phys., v. 14, 728-729
- (128) DAY, J. N. E. (1939) Heavy oxygen: Sci. Prog., v. 34, 47-54
- (129) DEGENS, E. (1959) Diagenesis and its effect on the chemistry of sediments: Neues Jahrb. Geol. u. Palaontol. Monatsh., No. 2, 72-84
- (130) DEGENS, E. (1959) The O^{18}/O^{16} ratio in the primordial ocean and geochemical changes: Neues Jahrb. Geol. u. Palaontol., Monatsh., No. 4, 180-186
- (131) DEGENS, E. T. (1961) Diagenesis of subsurface waters from the Libyan desert: Geol. Soc. Amer. Spec. Paper 68, 160

OXYGEN

39

- (132) DEGENS, E. T. and EPSTEIN, S. (1961) Stable isotope studies on marine and continental dolomites from recent and ancient sediments: Geol. Soc. Amer. Spec. Paper 68, 160-161
- (133) DEGENS, E. T. and EPSTEIN, S. (1962) Relation between O^{18}/O^{16} ratios in coexisting carbonates, cherts and diatomites: Bull. Amer. Assoc. Petrol. Geol. v. 46, 534-542
- (134) DEGENS, E. T. and EPSTEIN, S. (1964) Oxygen and carbon isotope ratios in coexisting calcites and dolomites from recent and ancient sediments: Geochimica et Cosmochimica Acta, v. 28, 23-44
- (135) DEGENS, E. T., HUNT, J. M. and REUTER, H. J. (1962) Geochemical data of petroleum brine waters of Paleozoic age from Oklahoma: Geol. Soc. Amer. 1962 Ann. Meet. Preprints p. 37A
- (136) DEGENS, E. T., PIERCE, W. D. and CHILINGAR, G. V. (1962) Origin of petroleum-bearing fresh-water concretions of Miocene age: Bull. Amer. Assoc. Petrol. Geol., v. 46, 1522-1525
- (137) DEMIDENKO, S. G. (1940) Isotopic composition of atmospheric precipitations: Acta Physicochim. U.S.S.R., v. 13, 305-311
- (138) DEVYATYKH, G. G. (1957) Calculation of the isotopic effect in the vapor pressure of water and methane: Zhur. Fiz. Khim., v. 31, 1445-1447
- (139) DEVYATYKH, G. G. (1958) The application of a statistical method for calculating the effect of isotopes on vapor pressure: Trudy Khim. i. Khim. Tehknol., v. 1, 239-249
- (140) DEVYATYKH, G. G. and ZORIN, A. D. (1956) The determination of the relative vapor pressures of $C^{13}H_4$ and O^{18} by the Rayleigh distillation method: Zhur. Fiz. Khim., v. 30, 1133-1139
- (141) DEVYATYKH, G. G., ZORIN, A. D. and NIKOLAEV, N. I. (1958) Separation of carbon and oxygen isotopes by fractional distillation of carbon monoxide, methane and molecular oxygen: Zhur. Priklad. Khim., v. 31, 368-375

OXYGEN
40

- (142) DIBELER, V. H. (1956) Isotope reference sample program at the National Bureau of Standards: Natl. Acad. Sci.-Natl. Research Council Publ. #400, 55-61
- (143) DOERING, W. v. E., and DORFMAN, E. (1953) Mechanism of the peracid Ketone-ester conversion. Analysis of organic compounds for oxygen-18: J. Am. Chem. Soc., v. 75, 5595-5598
- (144) DOLE, M. (1935) Relative atomic weight of oxygen in water and in air: J. Am. Chem. Soc., v. 57, 2731
- (145) DOLE, M. (1936) Atomic weight of oxygen in water and in air: J. Chem. Phys., v. 4, 268-275
- (146) DOLE, M. (1936) The relative atomic weight of oxygen in water and in air: J. Chem. Phys., v. 4, 778-780
- (147) DOLE, M. (1951) Chemistry of the isotopes of oxygen: Rev. brasili. quím. (Sao Paulo), v. 32, 124-131
- (148) DOLE, M. (1951) The origin of oxygen in the atmosphere and its isotopic composition: Bol. Soc. Quim. Peru, v. 17, 135-158
- (149) DOLE, M. (1952) The chemistry of the isotopes of oxygen: Chem. Revs., v. 51, 263-300
- (150) DOLE, M. (1956) Oxygen isotope cycle in nature: Natl. Acad. Sci.-Natl. Research Council Publ. #400, 13-19
- (151) DOLE, M., HAWKINS, R. C. and BARKER, H. A. (1947) Bacterial fractionation of oxygen isotopes: J. Am. Chem. Soc., v. 69, 226-228
- (152) DOLE, M. and JENKS, G. (1944) Isotopic composition of photosynthetic oxygen: Science, v. 100, 409
- (153) DOLE, M. and LANE, G. A. (1954) Fractionation of oxygen isotopes during the formation of metal oxide films: J. Chem. Phys., v. 22, 949-950
- (154) DOLE, M., LANE, G. A., RUDD, D. P. and ZAUKELES, D. A. (1954) Isotopic composition of atmospheric oxygen and nitrogen: Geochimica et Cosmochimica Acta, v. 6, 65-78

OXYGEN

41

- (155) DOLE, M. and SLOBOD, R.J. (1940) Isotopic composition of oxygen in carbonate rocks and iron oxide ores: J. Am. Chem. Soc., v. 62, 471-479
- (156) DONTSOVA, E.I. (1950) Investigation by the isotope method of conditions of formation of some minerals: Doklady Akad. Nauk, U.S.S.R., v. 71, 905-906
- (157) DONTSOVA, E.I. (1954) The exchange of isotopes of oxygen between natural forms of silica and carbon dioxide: Doklady Akad. Nauk U.S.S.R., v. 95, 1223-1226
- (158) DONTSOVA, E.I. (1955) Exchange of oxide-mineral oxygen with carbon dioxide: Doklady Akad. Nauk U.S.S.R., v. 105, 305-308
- (159) DONTSOVA, E.I. (1955) Investigation of the mobility of oxygen in silicates and aluminosilicates by the isotope tracer method: Doklady Akad. Nauk U.S.S.R., v. 103, 1065-1067
- (160) DONTSOVA, E.I. (1956) Exchange of oxygen isotopes between inorganic oxides and carbon dioxide and its application to determination of the area of active surfaces: Doklady Akad. Nauk, U.S.S.R., v. 110, 589-592
- (161) DONTSOVA, E.I. (1956) Problem of the isotopic composition and exchange equilibria of the oxygen of the lithosphere: Geokhimiya, 1956, No. 6, 61-72
- (162) DONTSOVA, E.I. (1959) Method for determining oxygen isotope ratios in rocks and minerals: Geokhimiya, in translation, 1959, No. 8, 824-838
- (163) DORMAN, F.H. and GILL, E.D. (1959) Oxygen isotope paleo-temperature measurements on Australian fossils: Proc. Roy. Soc. Victoria, v. 71, 73-98
- (164) DOROUGH, G.D. and CALVIN, M. (1951) The path of oxygen in photosynthesis: J. Am. Chem. Soc., v. 73, 2362-2365
- (165) DOSTROVSKY, I. and KLEIN, F.S. (1952) Mass spectrometric determination of oxygen in water samples: Anal. Chem., v. 24, 414-415

- (166) DOSTROVSKY, I., LLEWELLYN, D.R. and VROMEN, B.H. (1952) Separation of isotopes by fractional distillation I. Fractionating columns for the enrichment of the heavy isotopes of oxygen in water: J. Chem. Soc., 1952, 3509-3517; Pt. II Determination of parameters from production data. Value of the unit process separation factor for the $H_2O^{16}-H_2O^{18}$ system. I. Dostrovsky: J. Gillis, D.R. Llewellyn and B.H. Vromen, Ibid. 3517-3524
- (167) DOSTROVSKY, I. and SAMUEL, D. (1962) Oxygen-18, in, Inorganic isotopic syntheses, ed. by R.H. Herber. W.A. Benjamin (New York)
- (168) EDWARDS, R.R. (1952) Isotopic tracers in chemical systems: Ann. Rev. Nuclear Sci., v. 1, 301-335
- (169) EHHALT, D., KNOTT, K., NAGEL, J.F. and VOGEL, J.C. (1963) Deuterium and oxygen-18 in rain water: J. Geophys. Research, v. 68, 3775-3780
- (170) EMILIANI (1953) Oxygen isotopes and paleotemperature determinations: Actes 4th Congr. Intern. Quaternaire, Rome-Pisa, 1953, 831-844
- (171) EMILIANI, C. (1954) Depth habitats of some species of pelagic foraminifera as indicated by oxygen isotope ratios: Am. J. Sci., v. 252, 149-158
- (172) EMILIANI, C. (1954) Temperatures of Pacific bottom waters and polar superficial waters during the Tertiary: Science, v. 119, 853-855
- (173) EMILIANI, C. (1955) Pleistocene temperatures: J. Geology, v. 63, 538-578
- (174) EMILIANI, C. (1955) Pleistocene temperature variations in the Mediterranean: Quaternaria, v. 2, 87-98
- (175) EMILIANI, C. (1956) Oligocene and Miocene temperatures of the equatorial and subtropical Atlantic Ocean: J. Geology, v. 64, 281-288
- (176) EMILIANI, C. (1956) Oxygen isotope measurements of deep-sea sediments: Natl. Acad. Sci.-Natl. Research Council Publ. No. 473, 67-78

OXYGEN

43

- (177) EMILIANI, C. (1956) Note on absolute chronology of human evolution: *Science*, v. 123, 924-926
- (178) EMILIANI, C. (1957) Temperature and age analyses of deep-sea cores: *Science*, v. 125, 383
- (179) EMILIANI, C. (1958) Paleotemperature analysis of core 280 and Pleistocene correlations: *J. Geology*, v. 66, 264-275
- (180) EMILIANI, C. (1958) Ancient temperatures: *Scientific American*, v. 198, 54-63
- (181) EMILIANI, C. (1959) The relationship between paleotemperatures and carbonate content in a deep-sea core: A discussion: *J. Geology*, v. 67, 573-574
- (182) EMILIANI, C. (1961) The temperature decrease of surface sea-water in high latitudes and of abyssal-hadal waters in open oceanic basins during the past 75 million years: *Deep-Sea Research*, v. 8, 144-147
- (183) EMILIANI, C. (1963) O^{18}/O^{16} analysis of the Caribbean Cores A254-BR/C and CP-28, and a possibly continuous temperature record from the present to about 530,000 years ago: *Amer. Geophys. Union 1963 Ann. Meeting Preprints*, p. 16
- (184) EMILIANI, C., CARDINI, L. MAYEDA, T., McBURNEY, C.B.M. and TONGIORGI, E. (1964) Paleotemperature analysis of fossil shells of marine molluscs (food refuse) from the Arene Candide Cave, Italy and the Haua Fteah Cave, Cyrenaica, in, *Cosmic and Isotopic Chemistry*, ed. by H. Craig, S.L. Miller and G.J. Wasserburg, North Holland (Amsterdam), 133-156
- (185) EMILIANI, C. and EDWARDS, G. (1953) Tertiary ocean bottom temperatures: *Nature*, v. 171, 887-888
- (186) EMILIANI, C. and EPSTEIN, S. (1953) Temperature variations in the lower Pleistocene of southern California: *J. Geology*, v. 61, 171-181
- (187) EMILIANI, C., GIANOTTA, A., and MAYEDA, T. (1961) Isotope analyses of Sicilian foraminifera from clays of Ficarizzi, Palermo: *Quaternaria*, v. 5, 135-141

OXYGEN
44

- (188) EMILIANI, C. and MAYEDA, T. (1961) Carbonate and oxygen isotopic analysis of core 241A: J. Geology, 69, 729-732
- (189) EMILLIANI, C. and MAYEDA, T. (1964) Oxygen isotopic analysis of some molluscan shells from fossil littoral deposits of Pleistocene age: Am. J. Science, v. 262, 107-113
- (190) EMILIANI, C., MAYEDA, T. and SELLI, R. (1961) Paleotemperature analysis of the Plio-Pleistocene section at Le Castello, Calabria, Southern Italy: Bull. Geol. Soc. Amer., v. 72, 679-688
- (191) ENGEL, A.E.J. (1959) Review and evolution of studies of the O^{18}/O^{16} ratio in mineral deposits: Bull. Geol. Soc. Amer., v. 70, 1597
- (192) ENGEL, A.E.J., CLAYTON, R.N., and EPSTEIN, S. (1956) Symposium on geochemical prospecting, I. Variations in the isotopic composition of oxygen in the Leadville limestone (Mississippian) of Colorado as a guide to the location and origin of mineral deposits: Congr. Geol. Intern. 20th, Mexico City, 3-20
- (193) ENGEL, A.E.J., CLAYTON, R.N. and EPSTEIN, S. (1958) Variations in isotopic composition of oxygen and carbon in Leadville limestone (Mississippian, Colorado) and in its hydrothermal and metamorphic phases: J. Geology, v. 66, 374-393
- (194) EPSTEIN, S. (1953) Mass spectrometer for the measurement of small differences in isotope abundance ratios: Natl. Bur. Standards (U.S.) Circ. No. 522, 133-139
- (195) EPSTEIN, S. (1956) Variations of the O^{18}/O^{16} ratios of fresh waters and ice: Natl. Acad. Sci.-Natl. Research Council Publ. No. 400, 20-28
- (196) EPSTEIN, S. (1959) The variations of the O^{18}/O^{16} ratio in nature and some geologic implications, in, Researches in Geochemistry, P.H. Abelson, Editor. John Wiley and Sons, 217-240
- (197) EPSTEIN, S. (1960) Oxygen isotope measurements in glacial ice: Natl. Acad. Sci.-Natl. Research Council, Publ. No. 845, 102-105

OXYGEN
45

- (198) EPSTEIN, S. (1962) The oxygen isotopic compositions of marine waters: *J. Geophys. Research*, v. 67, 3555
- (199) EPSTEIN, S. and BENSON, C. (1959) Oxygen isotope studies: *Trans. Am. Geophys. Union*, v. 40, 81-84
- (200) EPSTEIN, S., BUCHSBAUM, R., LOWENSTAM, H. and UREY, H.C. (1951) Carbonate-water isotopic temperature scale: *Bull. Geol. Soc. Amer.*, v. 62, 417-426
- (201) EPSTEIN, E., BUCHSBAUM, R., LOWENSTAM, H.A. and UREY, H.C. (1953) Revised carbonate-water isotopic temperature scale: *Bull. Geol. Soc. Amer.*, v. 64, 1315-1326
- (202) EPSTEIN, S., DEGENS, E. and GRAF, D.L. (1962) The oxygen isotopic compositions of coexisting calcite and dolomite: *J. Geophys. Research*, v. 67, 1636
- (203) EPSTEIN, S., GRAF, D.L. and DEGENS, E.T. (1964) Oxygen isotope studies on the origin of dolomites, in, *Cosmic and Isotopic Chemistry*, ed. by H. Craig, S.L. Miller and G.J. Wasserburg, North Holland (Amsterdam), 169-180
- (204) EPSTEIN, S. and LOWENSTAM, H.A. (1953) Temperature-shell-growth relations of recent and interglacial Pleistocene shoal-water biota from Bermuda *J. Geology*, v. 61, 424-438
- (205) EPSTEIN, S. and MAYEDA, T. (1953) Variation of oxygen-18 content of waters from natural sources: *Geochimica et Cosmochimica Acta*, v. 4, 213-224
- (206) EPSTEIN, S. and SHARP, R.P. (1959) Oxygen isotope variations in the Malaspina and Saskatchewan glaciers: *J. Geology*, v. 67, 88-102
- (207) EPSTEIN, S., SHARP, R.P. and Vidziunas, I. (1960) Oxygen isotope ratios on the Blue Glacier, Olympic Mountains, Washington: *J. Geophys. Research*, v. 65, 2487
- (208) ERICSON, D.B., BROECKER, W.S., KULP, J.L. and WOLLIN, G. (1956) Late-Pleistocene climates and Deep-Sea sediments: *Science*, v. 124, 385-389

OXYGEN
46

- (209) ERICSON, D.B. and WOLLIN, G. (1956) Micropaleontological and isotopic determinations of Pleistocene climates: *Micropaleo.*, v. 2, 257-270
- (210) EVROPIN, V.A., KUL'KOVA, N.V. and TEMKIN, M.I. (1956) Kinetics of the reaction between carbon dioxide and carbon, and isotopic exchange: *Zhur. Fiz. Khim.*, v. 30, 348-365
- (211) FEDER, H.M. and TAUBE, H. (1952) Ionic hydration: an isotopic fractionation technique: *J. Chem. Phys.*, v. 20, 1335-1336
- (212) FINIKOV, V.G. (1964) Mechanism of the isotopic exchange of oxygen in the systems gas-solid at high temperatures: *Zh. Fiz. Khim.*, v. 38, 833-838
- (213) FINIKOV, V.G. and ZYKOVA, G.N. (1964) Isotope exchange of oxygen in systems WO_3-O_2 and $Na_2W_4O_{13}-O_2$: *Zh. Fiz. Khim.*, v. 38, 542-546
- (214) FLECK, R.N. (1957) Isotope separation process: U.S. Patent No. 2,780,526
- (215) FOGELSTRØM-FINEMAN, I., HOLM-HANSEN, O., TOLBERT, B.M. and CALVIN, M. (1957) Tracer study with oxygen-18 in photosynthesis by activation analysis: U.S. Atomic Energy Comm. UCRL-3790, 19 pp.
- (216) FONTES, J.C., GONFIANTINI, R. and TONGIORGI, E. (1963) Isotopic composition and origin of the evaporite series of the Paris Basin: *Compt. Rend. Soc. Geol. France*, 92-96
- (217) FONTES, J.C. et al. (1963) Isotopic composition and origin of thermal waters and gases in the Massif Central: *Acad. Sci. Paris, Compt. rend.*, v. 256, 472-474
- (218) FORCHHEIMER, O.L. and TAUBE, H. (1952) Evidence for the exchange of hydroxyl radical with water: *J. Am. Chem. Soc.*, v. 74, 3705-3706
- (219) FRIEDMAN, I. (1953) Deuterium content of natural waters and other substances: *Geochimica et Cosmochimica Acta*, v. 4, 89-103
- (220) FRIEDMAN, I. and HALL, W.E. (1963) Fractionation of O^{18}/O^{16} between coexisting calcite and dolomite: *J. Geology*, v. 71, 238-243

- (221) GABRIL'YAN, A.M. (1957) The total isotopic composition of waters from the Fergana petroleum-bearing region: Izvest. Akad. Nauk. Uzbek. S.S.R. Ser. Geol., 1957, No. 4, 47-55
- (222) GARLICK, G.D. and EPSTEIN, S. (1964) Oxygen isotope ratios in coexisting metamorphic minerals: Amer. Geophys. Union 1964 Ann. Meet. Preprints, 16
- (223) GEIB, K.H. (1938) Application of isotopes in chemical research: Angew. Chem., v. 51, 622-626
- (224) GIAUQUE, W.F. and JOHNSTON, H.L. (1929) An isotope of oxygen mass 18: J. Am. Chem. Soc., v. 51, 1436-1441; Nature, v. 123, 318
- (225) GIAUQUE, W.F. and JOHNSTON, H.L. (1929) An isotope of oxygen mass 17, in the earth's atmosphere: Nature, v. 123; J. Am. Chem. Soc., v. 51, 3528-3534
- (226) GILFILLAN, E.S.. Jr. (1934) The isotopic composition of sea water: J. Am. Chem. Soc., v. 56, 406-538
- (227) GOLDBERG, L., MOHLER, O.C. and McMATH, R.R. (1948) Isotopes of carbon and oxygen in the earth's atmosphere: Phys. Rev., v. 74, 1881-1882
- (228) GONFIANTINI, R. and FONTES, J.C. (1963) Oxygen isotopic fractionation in the water of crystallization of gypsum: Nature, v. 200, 644-646
- (229) GONFIANTINI, R. and LONGINELLI, A. (1962) Isotopic oxygen composition of fogs and rains from the North Atlantic: Experimentia, v. 18, 222-223
- (230) GONFIANTINI, R. and PICCIOTTO, E. (1959) Oxygen isotope variations in Antarctic snow samples: Nature, v. 184, 1557-1558
- (231) GONFIANTINI, R. TOGLIATTI, V. and TONGIORGI, E. (1963) Some possible applications of isotopic analyses of water to hydrologic problems: Consiglio Nazionale delle Ricerche, 71-80
- (232) GONFIANTINI, R., TOGLIATTI, V., TONGIORGI, E., BREUCK, W. de and PICCIOTTO, E. (1963) Snow stratigraphy and oxygen isotope variations in the glaciological pit of King Baudouin Station, Queen Maud Land, Antarctica: J. Geophys. Research, v. 68, 3791-3798

- (233) GONFIANTINI, R., TOGLIATTI, V., TONGIORGI, E., BREUCK, W. de, and PICCIOTTO, E. (1963) Geographical variations of oxygen-18/oxygen-16 in surface snow and ice from Queen Maud Land, Antarctica: Nature, v. 197, 1096-1098
- (234) GRAF, D.L. (1960) Geochemistry of carbonate sediments and sedimentary carbonate rocks IV-A Isotopic composition and chemical analyses: Ill. State Geol. Surv. Circ. No. 308, 42 pp
- (235) GRAUPNER, K. and WINTER, E.R.S. (1952) Self-diffusion coefficients of liquids: J. Chem. Soc., 1952, 1145-1150
- (236) GREEN, M. and TAUBE, H. (1963) Isotopic fractionation in the OH⁻-H₂O exchange reaction: J. Phys., v. 67, 1565-1566
- (237) GREENE, C.H. and VOSKUIL, R.J. (1934) Separation of the oxygen isotopes: J. Am. Chem. Soc., v. 56, 1649
- (238) GREENE, C.H. and VOSKUIL, R.J. (1936) Explanation of the relatively large concentration of O¹⁸ in the atmosphere: J. Am. Chem. Soc., v. 58, 693-694
- (239) GROSS, M.G. (1961) O¹⁸/O¹⁶ and C¹³/C¹² ratios of diagenetically altered limestones in the Bermuda Islands, Bikini and Eniwetok Atolls: Geol. Soc. Amer. Spec. Paper 68, 187
- (240) GROSS, M.G. (1964) Variations in the O¹⁸/O¹⁶ and C¹³/C¹² ratios of diagenetically altered limestones in the Bermuda Islands: J. Geology, v. 72, 170-194
- (241) GROSSE, A.V., HINDIN, S.G. and KIRSHENBAUM, A.D. (1946) Elementary isotopic analysis: determination of oxygen: J. Am. Chem. Soc., v. 68, 2119; Anal. Chem., v. 21, 386-390 (1949)
- (242) GROSSE, A.V. and KIRSHENBAUM, A.D. (1952) Direct determination of oxygen in organic compounds by elementary isotopic analysis: Anal. Chem., v. 24, 584-585
- (243) GROTH, W., IHLE, H. and MURRENHOFF, A. (1956) Determination of the vapor-pressure ratio O¹⁶O¹⁶/O¹⁸O¹⁸ between 63 and 74°K: Angew. Chem., v. 68, 644-648

OXYGEN
49

- (244) HAISSINSKY, M. and DAUDEL, R. (1947) Isotope exchange and the nature of the chemical bond: Bull. Soc. Chim. France, 552-559
- (245) HALL, N. F. and ALEXANDER, O. R. (1940) Oxygen exchange between anions and water: J. Am. Chem. Soc., v. 62, 3455-3462
- (246) HALL, W. H. and HOCHANADEL, C. (1940) Isotopic composition of cuprite oxygen: J. Am. Chem. Soc., v. 62, 3259-3260
- (247) HARADA, M. and TITANI, T. (1935) Isotopic composition of rain and snow water: Chem. Soc. Japan, v. 10, 206
- (248) HART, E. J., GORDON, S. and HUTCHISON, D. A. (1953) Free-radical-initiated $\text{O}^{16}\text{O}^{18}-\text{H}_2\text{O}^{16}$ exchange reaction in aqueous solution: J. Am. Chem. Soc., v. 75, 6165-6169
- (249) HART, E. J. and HUTCHINSON, D. A. (1952) Free-radical-initiated $\text{O}^{16}\text{O}^{18}-\text{H}_2\text{O}^{16}$ exchange reaction in aqueous solutions: J. Am. Chem. Soc., v. 74, 5548-5549
- (250) HAUL, R. A. W. (1954) Separation of isotopes by means of surface diffusion in porous media: Naturwissenschaften, v. 41, 255-256
- (251) HERRON, J. T. and KLEIN, F. S. (1964) Mass spectrometric study of the isotopic exchange rate of oxygen atoms with O_2 , NO and NO_2 : J. Chem. Phys., v. 40, 2731
- (252) HEYMANN, D. and KISTEMAKER, J. (1956) Separation of some isotopes by convection diffusion: Jour. Chem. Phys., v. 24, 165-166
- (253) HOEKSTRA, H. R. (1956) Oxygen isotope variations in some uranium minerals: Natl. Acad. Sci.-Natl. Research Council Publ. No. 400, Nuclear Science Series, Rept. 19, 160-165
- (254) HOEKSTRA, H. R. and KATZ, J. J. (1956) Isotope geology of some uranium minerals: U. S. Geol. Survey Prof. Paper No. 300, 543-547

OXYGEN
50

- (255) HOERING, T.C. (1961) The effect of physical changes on isotope fractionation: Carnegie Inst. Washington, Papers Geophys. Lab. No. 1363, 201-204
- (256) HOLMES, A. (1958) Spitskop carbonatite, Eastern Transvaal: Bull. Geol. Soc. Amer., v. 69, 1525-1526
- (257) HOLT, A.S. and FRENCH, C.S. (1949) Isotopic analysis of the oxygen evolved by illuminated chloroplasts in normal water and in water enriched with oxygen-18: Arch. Biochem. Biophys., v. 19, 429-435
- (258) HOUGHTON, G. and WINTER, E.R.S. (1949) Exchange of oxygen¹⁸ between oxides and gaseous oxygen: Nature, v. 164, 1130-1131
- (259) HUFFMAN, J.R. and UREY, H.C. (1937) Separation of oxygen by a fractionating column: Ind. Eng. Chem., v. 29, 531-535
- (260) HUNT, J.P. and TAUBE, H. (1951) The exchange of water between hydrated cations and solvent: J. Chem. Phys., v. 19, 602-609
- (261) HUTCHISON, D.A. (1954) Isotopic exchange of oxygen in the systems water-silica and oxygen-silica: J. Chem. Phys., v. 22, 758-759
- (262) HVIDT, A., JOHANSEN, G., LINDERSTRØM-LAND, K. and VASLOW, F. (1954) Exchange of deuterium and oxygen-18 between water and other substances: Medd. Carlsberg Lab., v. 29, 129-157
- (263) HYDE, J.L. (1941) Exchange of sulfate ion with water: J. Am. Chem. Soc., v. 63, 873-874
- (264) INGERSON, E. (1953) Non-radiogenic isotopes in geology: a review: Bull. Geol. Soc. Amer., v. 64, 301-374
- (265) ISBERG, P. and LUNDBERG, L. (1954) Density of heavy water and electrolytic enrichment of the oxygen isotopes: Z. Naturforsch., v. 9a, 472-473

OXYGEN
51

- (266) JAMES, H.L. (1959) General features of stable isotope research, as applied to problems of ore deposits: Bull. Geol. Soc. Amer., v. 70, 1623
- (267) JAMES, H.L. and CLAYTON, R.N. (1962) Oxygen isotope fractionation in metamorphosed iron formations of the Lake Superior region and in other iron-rich rocks: Geol. Soc. Am., Buddington Vol., 217-239
- (268) JENSEN, M.L. (1953) Isotopic study of fluid inclusions: Proc. Conf. Nuclear Processes in Geol. Settings, Univ. Chicago, Natl. Research Council, Nat. Sci. Foundation, 73-75
- (269) JOHNS, T.F., KRONBERGER, H. and LONDON, H. (1950) Enrichment of the heavy isotopes of carbon and oxygen by fractional distillation of carbon monoxide: Mass. Spectrometry (London), 1950, 141-147
- (270) JOHNSTON, W.H. (1953) Homomolecular reactions: A new field of study in chemistry: Proc. Indiana Acad. Sci., v. 63, 136-137
- (271) JOHNSTON, W.H. and O'SHEA, C.J. (1953) The homomolecular exchange of oxygen: J. Chem. Phys., v. 21, 2080
- (272) JONES, T.O. and HALL, N.F. (1937) The relative atomic weight of oxygen from air and water determined by an interchange reaction: J. Am. Chem. Soc., v. 59, 259-261
- (273) JONES, W.M. (1954) Isotopes: Ann. Rev. Phys. Chem., v. 5 91-118
- (274) KALLMANN, H. and LASAREFF, W. (1933) Investigations of isotopes (oxygen, neon and chlorine): Z. Physik, v. 80, 237-241
- (275) KAMEN, M.D. and BARKER, H.A. (1945) Inadequacies in present knowledge of the relation between photosynthesis and O^{18} content of atmospheric oxygen: Proc. Natl. Acad. Sci., v. 31, 8-15

OXYGEN
52

- (276) KARPACHEVA, S.M. and ROZEN, A.M. (1953) The mobility of the oxygen of manganese dioxide and the catalytic oxidation of carbon monoxide: Zhur. Fiz. Khim., v. 27, 146-149
- (277) KARPACHEVA, S.M. and ROZEN, A.M. (1953) The movement of oxygen of several solid bodies and the "geologic thermometer" of Yuri-Nir: Doklady Akad. Nauk U.S.S.R., v. 88, 709-710
- (278) KARPACHEVA, S.M., ROZEN, A.M., SAMSONOVA, L.I. and STEPANOVA, S.N. (1957) A simplified floating method for measuring liquid density: Zhur. Anal. Khim., v. 12, 240-245
- (279) KASATKINA, L.A. and BORESKOV, G.K. (1955) Isotope exchange on manganese dioxide with oxygen and steam: Zhur. Fiz. Khim., v. 29, 455-462
- (280) KASATKINA, I.A. and FLORENSKII, K.P. (1941) Isotopic composition of the water of some seas and salt lakes: Compt. Rend. Acad. Sci., U.S.S.R., v. 30, 822-823
- (281) KASHIDA, T. and KAWAGUCNK, S. (1950) Atomic weight of oxygen in natural minerals: I. Carbonate minerals: Collected Papers Fac. Sci., Osaka Univ., v. 11, 1-3
- (282) KAZARNOVSKII, I.A., LIPIKHIN, N.P. and TIKHOMIROV, M.V. (1956) Isotopic exchange of oxygen between free hydroxyl radicals and water: Nature, v. 178, 100-101
- (283) KAZARNOVSKII, I.A., LIPIKHIN, N.P. and TIKHOMIROV, M.V. (1956) Isotopic exchange of oxygen between free hydroxyl radicals and water: Zhur. Fiz. Khim., v. 30, 1429-1430
- (284) KEISCH, B. (1957) The kinetics of oxygen exchange between phosphoric acid and water: Dissertation Abstracts, v. 17, 757
- (285) KEITH, M.L., TUVE, M.A., DAVIS, G.L. and DOAK, J.B. (1952) Ratio of oxygen isotopes in quartz of contrasted origin: Bull. Geol. Soc. Amer., v. 63, 1270

- (286) KEITH, M.L. and ANDERSON, G.M. (1962) Isotopic within-shell variation in mollusks in relation to their environment: Geol. Soc. Amer. 1962 Ann. Meet., Preprints, p. 85A
- (287) KEITH, M.L. and DEGENS, E.T. (1959) Geochemical indicators of marine and fresh-water sediments: in, Researches in Geochemistry, ed. by P.H. Abelson Wiley (London) 38-61
- (288) KEITH, M.L., EICHLER, R. and PARKER, R.H. (1960) Carbon and oxygen isotope ratios in marine and fresh-water mollusk shells: Bull. Geol. Soc. Amer., v. 71, 1901-1902
- (289) KHASKIN, I.G. (1952) Some applications of deuterium and of heavy oxygen to the chemistry of silicon: Doklady Akad. Nauk U.S.S.R., v. 85, 129-132
- (290) KHASKIN, I.G. (1953) Oxygen exchange and hydrolysis of some silicon compounds: Sbornik Statei Obshchei Khim., v. 2, 153⁴-1539
- (291) KHITROV, L.M. and ZADOROZHNYI, I.K. (1960) Fractionation of oxygen isotopes in soils: Pochvovedenie No. 1, 5-14
- (292) KIRSHENBAUM, I. (1951) Physical properties and analysis of heavy water: Nat. Nuclear Energy Ser., Div. III, 4A, 438 pp
- (293) KIRSHENBAUM, A.D. (1954) Extension of isotopic methods for the determination of oxygen in titanium to range 0.02 to 0.2 weight percent: Rept. 126th Meet. Anal. Div., Am. Chem. Soc., New York, p. 3B
- (294) KIRSHENBAUM, A.D. (1957) Isotope method for determination of oxygen in chromium: Anal. Chem., v. 29, 980-981
- (295) KISTEMAKER, J. (1953) Influence of fractionizing and viscosity effects in mass spectrometric gas-handling systems: Natl. Bur. Standards (U.S.) Circ. 522, 243-247

OXYGEN

54

- (296) KLEIN, R. and FRIEDEL, R.A. (1950) Oxygen exchange between nitrates and water: J. Am. Chem. Soc., v. 72, 3810-3811
- (297) KLIER, K., NOVAKOVA, J. and JIRU, P. (1963) Exchange reactions of oxygen between oxygen molecules and solid oxides: J. Catalysis, v. 2, 479-484
- (298) KNOP, L. (1955) Information on the isotope abundance of domestic, natural and industrial waters: Slovensk. Acad. Sci. Arts J. Stefan Inst. Phys. Repts., v. 2, 77-85
- (299) KNOP, L. and KRISTAN, J. (1956) Water isotope disproportionation according to some transformation processes of normal waters: J. Stefan Inst. Repts., v. 3, 141-148
- (300) KNOP, L. and STERN, F. (1956) Isotope enrichment in slow evaporation of water: J. Stefan Inst. Repts., v. 3, 149-156
- (301) KRAUSE, I.M. and LINDESTRØM-LANG, K. (1955) Exchange of deuterium and oxygen-18 between water and other substances: Compt. rend. trav. lab. Carlsberg, v. 29, 367-384
- (302) KRELL, E. (1957) Separation and application of stable isotopes I. Preparation of stable isotopes as a distillation problem: Chem. Tech., v. 9, 333-340
- (303) KRELL, E. (1960) Production of the stable O^{18} isotope by means of countercurrent distillation of water: Chem.-Ing.-Tech., v. 32, 233-240
- (304) KRUMBIEGEL, P. (1960) Suggestions for a possible application of stable isotopes in silicate chemistry: Silikat. Tech., v. 11, 511-553
- (305) KUDRYAVTSEV, R.V., OTTESEN, B.V. and KURSANOV, D.N. (1956) Determination of isotope composition of oxygen in organic compounds: Zhur. Obshchey Khim., v. 26, 1035-1039

- (306) KUHN, W., NARTEN, A., and THURKAUF, M. (1959) Separation factor of isotopic nitrogen oxides. $N^{15}N^{14}O/N_2^{14}O$, N_2O^{18}/N_2O^{16} , $N^{15}O/N^{14}O$, $N^{15}O_2/N^{14}O_2$: Helv. Chim. Acta, v. 42, 1433-1436
- (307) KUHN, W. and THURKAUF, M. (1958) Isotope separation during the freezing of water and diffusion constants of deuterium and oxygen-18 in ice: Helv. Chim. Acta, v. 41, 938-971
- (308) KUL'KOVA, N.V., KUZNETS, Z.D. and TEMKIN, M.I. (1953) The exchange of oxygen isotopes between carbon monoxide and carbon dioxide on an iron oxide catalyst: Doklady Akad. Nauk U.S.S.R., v. 90, 1067-1070
- (309) KURSANOV, A.L. (1954) The significance of isotopes and other new methods of investigation in biology for the solution of problems of agriculture: Izvest. Akad. Nauk U.S.S.R., Ser. Biol., 1954, No. 1, 8-19
- (310) KUTYURIN, V.M., VOSKRESENSKAYA, N.P., ULUBEKOVA, M.V., GRISHINA, G.S. and ZADOROZHNYI, I.K. (1964) Effect of the spectral composition of light on fractionation of oxygen isotopes absorbed by water plants: Fiziol. Rast., v. 11, 7-12
- (311) LANE, G.A. (1955) The fractionation of oxygen isotopes: Dissertation Abstracts, v. 15, 1736-1737
- (312) LANE, G.A. and DOLE, M. (1956) Fractionation of oxygen isotopes during respiration: Science, v. 123, 574-576
- (313) LAUDER, I. (1947) Separation of the oxygen isotopes by thermal diffusion: Trans. Faraday Soc., v. 43, 620-630
- (314) LAUDER, I. (1950) Use of the heavy oxygen isotope, O^{18} , as a tracer element, I: Proc. Conf. Applications Isotopes Sci. Research, Univ. Melbourne, 111-116; II. Ibid., 117-124
- (315) LAZAREV, A.Z., AREF'EVA, M.G., BOBYREV, N.A., CHAPUKHIN, M.S. and KHAIDAROV, A.A. (1958) Isotope composition of some elements of gold-bearing ore deposits: Trudy Tsentral. Nauch-Issledovatel. Gornorazvedoch. Inst., No. 27, 12-14

OXYGEN
56

- (316) LEE, K.H. (1951) Calculation of the equilibrium constant for the exchange of oxygen isotopes between water molecules and phosphate ions: J. Chin. Chem. Soc., v. 18, 121-134
- (317) LEE, K.H. (1963) Evaluation of $\text{PO}_4^{3-}-\text{H}_2\text{O}(l)$ paleotemperature scale: Sinica Acta, 1937-1958
- (318) LEIGHTON, M.W. (1954) Petrogenesis of a gabbro-granophyre complex in northern Wisconsin: Bull. Geol. Soc. Amer., v. 65, 401-442
- (319) LEWIS, G.N. and LUTEN, D.B. Jr., (1933) Refractive index of H_2O^{18} and the complete isotopic analysis of water: J. Am. Chem. Soc., v. 55, 5061-5062
- (320) LIFSON, N., GORDON, G.B. and MCCLINTOCK, R. (1955) Measurement of total carbon dioxide production by means of D_2O^{18} : J. Appl. Physiol., v. 7, 704-710
- (321) LIND, S.C. (1930) The origin of oxygen-17: Phys. Rev., v. 35, 1408
- (322) LLOYD, R.M. (1964) Variations in the oxygen and carbon isotope ratios of Florida Bay molluscs and their environmental significance: J. Geology, v. 72, 84-111
- (323) LONGINELLI, A. and TONGIORGI, E. (1964) Oxygen isotopic composition of some right and left coiled foraminifera: Science, v. 144, 1004-1005
- (324) LOVERING, T.S., McCARTHY, J.H. and FRIEDMAN, I. (1963) Significance of $\text{O}^{18}/\text{O}^{16}$ and $\text{C}^{13}/\text{C}^{12}$ ratios in hydrothermally dolomitized limestones and manganese carbonate replacement ores of the Drum Mountains, Juab Co., Utah: U.S. Geol. Surv. Prof. Paper No. 475-B, 1-19
- (325) LOWENSTAM, H.A. (1960) $\text{O}^{18}/\text{O}^{16}$ ratios and Sr and Mg contents in recent and fossil articulate brachiopods and their relationship to the water chemistry: Bull. Geol. Soc. Amer., v. 71, 2065-2066

- (326) LOWENSTAM, H.A. (1961) Isotopes and trace elements in paleoecology: Geol. Soc. Amer. Spec. Paper 68, 220
- (327) LOWENSTAM, H.A. (1961) Mineralogy, O^{18}/O^{16} ratios, and strontium and magnesium contents of recent and fossil brachiopods and their bearing on the history of the oceans: J. Geology, v. 69, 241-260
- (328) LOWENSTAM, H.A. (1963) Biologic problems relating to the composition and diagenesis of sediments: in, Problems and progress in current research in the Earth Sciences, ed. by T.W. Donnelly, Univ. Chicago Press, 137-195
- (329) LOWENSTAM, H.A. and EPSTEIN, S. (1954) Paleotemperatures of the post-Aptian Cretaceous as determined by the oxygen isotope method: J. Geology, v. 62, 207-248
- (330) LOWENSTAM, H.A. and EPSTEIN, S. (1957) On the origin of sedimentary aragonite needles of the Great Bahama Bank: J. Geology, v. 65, 364-375
- (331) LUNELUND, H. (1935) Hydrogen and oxygen isotopes and heavy water: Tek. Fören. Finland Förh., v. 55, 35-39
- (332) L'VOV, B.B., MOSICHEV, V.I. and SENYUTA, S.A. (1962) Quantitative spectral determination of isotopic composition of oxygen: Zavodsk. Lab., v. 28, 1322-1324
- (333) MAASS, I. (1960) O^{18} exchange between water and instrument glass. I.: Kernenergie, v. 3, 843-846
- (334) MAASS, I. (1961) Isotope geology with hydrogen, carbon and oxygen: Ber. Geol. Ges. Deut. Demokrat. Rep., Gesamtgebiet. Geol. Wiss., v. 6, 408-418
- (335) MACKENZIE, H.A.E. and MALHERBE, P.N. (1951) Isotopes II, Isotopic equilibrium during the fractional distillation with appreciable hold-up in the still pot: J.S. African Chem. Inst., v. 4, 63-68
- (336) MACKENZIE, H.A.E. and MALHERBE, P.N. (1951) Isotopes III. Performance of stainless steel gauze ring packing in the isotopic fractionation of water: J.S. African Chem. Inst., v. 4, 69-78

OXYGEN
58

- (337) MACKENZIE, H.A.E. and MILNER, A.M. (1951) Isotopes I.
Isotopic composition of water which has
been enriched in heavy isotopes by fractionation:
J. S. African Chem. Inst., v. 4, 57-62
- (338) MACKENZIE, H.A.E. and MILNER, A.M. (1951) Isotopes
IV. Catalysis of isotopic exchange between
gaseous oxygen and liquid water: J.S.
African Chem. Inst., v. 4, 79-82
- (339) MACKENZIE, H.A.E. and MILNER, A.M. (1953) Exchange of
oxygen isotopes between water and hydrated
chromic chloride: Trans. Faraday Soc., v. 49,
1437-1443
- (340) MANIAN, S.H., UREY, H.C. and BLEAKNEY, W. (1934)
The relative abundance of the oxygen isotopes
 $O^{16}:O^{18}$ in stone meteorites: J. Am. Chem. Soc.,
v. 56, 2601-2609
- (341) MAYR, F.X. (1964) Carbonate thermometer for the determination
of the temperature of primeval oceans:
Naturw. Rundschau, v. 17, 61-63
- (342) McCARTHY, J.H. Jr., LOVERING, T.S. and Lakin, H.W. (1961)
Density comparison method for the determination
of O^{18}/O^{16} in prepared waters: U.S. Geol.
Survey Paper 424-C, 387-389
- (343) McCREA, J.M. (1950) On the isotopic chemistry of
carbonates and a paleotemperature scale: J.
Chem. Phys., v. 18, 849-857
- (344) McKELLAR, A. (1949) Isotopes in stellar atmospheres:
Astron. Soc. Pacific, v. 61, 199-209
- (345) McKINNEY, C.R., McCREA, J.M., EPSTEIN, S., ALLEN, H.A.
and UREY, H.C. (1950) Improvements in mass
spectrometers for the measurement of small
differences in isotope abundance ratios: Rev.
Sci. Instruments, v. 21, 724-730
- (346) McQUEEN, J.H. (1950) Isotopic separation due to settling
in the atmosphere: Phys. Rev., v. 80, 100-101
- (347) MECKE, R. and CHILDS, W.H.J. (1931) The Atomic weight of
oxygen: Z. Physik, v. 68, 362-377

OXYGEN
59

- (348) MECKE, R. and WURM, K. (1930) The atomic weight of the oxygen isotope, oxygen-18: Z. Physik, v. 61, 37-45
- (349) MIGEOTTE, M., NEVEN, L. and SWENSON, J. (1957) Solar spectrum from 2.8 to 23.7 microns II, Data and identifications: Mem. Soc. Roy. Sci. Liege, No. 2, 30 pp
- (350) MIKLUKHIN, G.P. and BRODSKII, A.I. (1942) Investigations of the mechanism of chemical reactions with the help of oxygen isotopes: Acta Physicochim. U.S.S.R., v. 16, 63-70
- (351) MILLS, G.A. (1940) Oxygen exchange between water and inorganic oxyanions: J. Am. Chem. Soc., v. 62, 2833-2838
- (352) MILLS, G.A. and UREY, H.C. (1939) Oxygen exchange between carbon dioxide, bicarbonate ion, carbonate ion, and water: J. Am. Chem. Soc., v. 61, 534
- (353) MILLS, G.A. and UREY, H.C. (1940) The kinetics of isotopic exchange between carbon dioxide, bicarbonate ion, carbonate ion and water: J. Am. Chem. Soc., v. 62, 1019-1026
- (354) MIYAKE, Y. (1952) The problem of oxygen isotopes and geochemistry: Measurement of paleotemperature, etc.: Kagaku no Ryoiki, v. 6, 222-227
- (355) MORI, H., HIROTA, K. and KOBAYASHI, Y. (1955) Isotopic exchange reaction between heavy oxygen and carbon dioxide on silver catalyst: Bull. Chem. Soc. Japan, v. 28, 532-533
- (356) MORITA, N. (1936) Difference between heavy oxygen content of ordinary water and air: J. Chem. Soc. Japan, v. 57. 176-179
- (357) MORITA, N. (1943) The catalytic exchange of isotopes of gaseous oxygen XIII: Bull. Chem. Soc. Japan, v. 17, 242-247
- (358) MORITA, N. and TITANI, T. (1936) The difference in the isotopic composition of oxygen from the atmosphere and from water: Bull. Chem. Soc. Japan, v. 11, 36-38

OXYGEN
60

- (359) MORITA, N. and TITANI, T. (1936) Difference between the heavy oxygen contents of ordinary water and air: Bull. Chem. Soc. Japan, v. 11, 414-418
- (360) MORITA, N. and TITANI, T. (1936) Effect of the density difference between air- and water-oxygen on results on oxygen and hydrogen isotopes: Bull. Chem. Soc. Japan, v. 11, 419-424
- (361) MORITA, N. and YAMAMOTO, I. (1944) The effect of pressure on the concentration of heavy oxygen by fractional distillation of water: J. Chem. Soc. Japan, v. 65, 780-781
- (362) MUCKENTHALER, H. (1934) Mass-spectrographic experiments on the isotopes of oxygen and hydrogen: Physik. Z., v. 35, 851-857
- (363) MURPHEY, B.F. (1941) Relative abundance of the oxygen isotopes: Phys. Rev., v. 59, 320
- (364) MURPHY, G.M. and BRANDT, P.F. (1937) Chemical atomic weights and the relative abundance of the oxygen isotopes: J. Chem. Phys., v. 5, 274
- (365) MURPHY, G.M. and UREY, H.C. (1932) The relative abundance of the nitrogen and oxygen isotopes: Phys. Rev., v. 41, 141-148
- (366) NAIDIN, D.P., TEIS, R.V. and CHUPAKHIN, M.S. (1956) Determination of climatic conditions of some regions of the USSR in the Upper Cretaceous period by the method of isotopic paleothermometry: Geokhimiya 1956, No. 8, 23-34
- (367) NAUDE, S.M. (1930) The isotopes of nitrogen, mass 15, and oxygen, masses 18 and 17 and their abundances: Phys. Rev., v. 36, 333-346
- (368) NIER, A.O. (1950) A redetermination of the relative abundances of the isotopes of carbon, nitrogen, oxygen, argon, and potassium: Phys. Rev., v. 77, 789-793
- (369) NIER, A.O. (1953) Present status of isotopic abundances: Natl. Bur. Standards (U.S.) Circ. #522, 131-132
- (370) NOVAKOVA, J. (1963) Isotopic exchange of O^{18} with oxide catalysts: Chem. Listy, v. 57, 797-802

OXYGEN
61

- (371) OAE, S. and KITAO, T. (1961) Elucidation of mechanisms of organic reactions using oxygen-18 as a tracer: *Yuki Gosei Kagaku Kyokai Shi*, v. 19, 880-899
- (372) OANA, S. (1939) Geochemical research on Japanese volcanos: *Bull. Chem. Soc. Japan*, v. 14, 279-283
- (373) OANA, S. (1942) Geochemical studies of volcanos in Japan: *Bull. Chem. Soc. Japan*, v. 17, 302-304; 314-320; 377-379; 397-416
- (374) OANA, S. (1942) Heavy water in the thermal water of Kusatu: *Mitt. deut. Ges. u. Natur-Völkerkunde Ostasiens*, v. 33C, 15-19
- (375) OANA, S. (1948) Distribution of heavy water in natural waters: *Chem. Reseaces*, v. 3, 71-90
- (376) OANA, S. (1953) Distribution of heavy water in natural waters: *J. Earth Sci. Nagoya Univ.*, v. 1, 42-61
- (377) OANA, S. (1956) Geochemistry of isotopes: *Kagaku*, v. 26, 331-336
- (378) OANA, S. and KURODA, K. (1943) The radium spa Masutomi and springs alien to their environment, III Significance and determination of the trace elements: *Mitt. deut. Ges. Natur-u. Völkerkunde Ostasiens*, v. 33E, 6-14
- (379) OGAWA, E. (1936) Mechanism of isotopic exchange reaction: *Bull Chem. Soc. Japan*, v. 11, 425-427
- (380) OGAWA, E. (1936) The isotopic separation of oxygen, chlorine, bromine, and nitrogen by chemical methods: *Bull. Chem. Soc. Japan*, v. 11, 428-430
- (381) OGDEN, G. (1935) Electrolytic separation of the oxygen isotopes: *Nature*, v. 136, 912
- (382) OGG, R.A., Jr. (1953) Chlorine-photosensitized isotope exchange between molecular oxygen species: *J. Chem. Phys.* v. 21, 2078-2079
- (383) OGG, R.A., Jr. and SUTPHEN, W.T. (1953) Ozone catalysis of isotope exchange between molecular oxygen species: *J. Chem. Phys.*, v. 21, 2078

- (384) OGG, R.A., Jr. and SUTPHEN, W.T. (1954) Reactions of atomic oxygen with molecular oxygen: Discussions Faraday Soc. No. 17, 47-54
- (385) OKABE, K. and TITANI, T. (1935) The concentration of heavy isotopes in cellulose: Bull. Chem. Soc. Japan, v. 10, 465-466
- (386) OLARIU, A. (1962) Optimal regime for total separation of the light isotopes (C^{13} , N^{15} and O^{18}) and stage arrangement of separation installations: Acad. Rep. Populară Române, Studii Cercetari Fiz., v. 13, 933-938
- (387) O'NEIL, J.R. and CLAYTON, R.N. (1961) Oxygen isotope fractionation in the system quartz-water: Geol. Soc. Amer. Spec. Paper 68, 241-242
- (388) O'NEIL, J.R. and CLAYTON, R.N. (1964) Oxygen isotope geothermometry: in, Cosmic and Isotopic Chemistry, ed. by H. Craig, S.L. Miller and G.J. Wasserburg, North Holland (Amsterdam) 157-168
- (389) O'NEIL, J.R. and EPSTEIN, S. (1964) Oxygen isotope fractionation between dolomite and calcite: Amer. Geophys. Union 1964 Ann. Meet. Preprints, 16
- (390) OSUMI, Y. and MORITA, N. (1942) The catalytic exchange of isotopes of gaseous oxygen XI: Bull. Chem. Soc. Japan, v. 17, 217-220
- (391) OSUMI, Y., MORITA, N. and CHITANI, T. (1942) The catalytic exchange of isotopes of gaseous oxygen XII: Bull. Chem. Soc. Japan, v. 17, 189-196
- (392) OZIASHVILI, E.D., NIKOLAEV, YU.V. and MYASOEDOV, N.F. (1962) The possibility of using isotope exchange between NO and H_2O in nitric acid solutions in order to concentrate O^{18} : Soobschch. Akad. Nauk Gruz. S.S.R., v. 29, 289-292
- (393) PANCHENKO, V.G. (1951) Isotopes: Priroda, v. 39, No. 8, 16-26
- (394) PANCHENKOV, G.M. (1963) Separation of stable isotopes by chemical and ion-exchange methods: J. Chim. Phys., v. 60, 107-114

OXYGEN

63

- (395) PANCHENKOV, G.M. and MOISEEV, V.D. (1956) Concentration of the carbon-13 and oxygen-18 isotopes in carbon monoxide by the method of thermal diffusion: Zhur. Fiz. Khim., v. 30, 1662-1667
- (396) PANCHENKOV, G.M., SEMIOKHIN, I.A. and AKISHIN, P.A. (1957) Chemistry and separation of isotopes: Vestnik Moskov. Univer., Ser. Mat., Mekh., Astron., Fiz. Khim., v. 12, 199-214 (1957)
- (397) PANCHENKOV, G.M., TOLMACHEV, A.M. and KONDRATOVA, V.B. (1959) New method of isotope separation: Zhur. Fiz. Khim., v. 33, 734-735
- (398) PARRAVANO, N. and PESCE, B. (1938) Isotopic composition of natural waters: Atti X° congr. intern. chim., v. 2, 401-411
- (399) PARRAVANO, N. and PESCE, B. (1938) Isotopic composition of rain water: Atti X° congr. intern. chim., v. 2, 412-415
- (400) PEREDEREV, V.A. (1955) The isotopic composition of oxygen of pyrolusites, maganites and psilomelanes of the Nikopol region: Mineral. Sbornik Lvov Geol. Obshchestvo, v. 9, 221-225
- (401) PESCE, B. and CERVONE, S. (1940) The isotopic composition of atmospheric humidity: Gazz. Chim. Ital., v. 70, 727-728
- (402) PETROVSKAYA, N.V. and GRINENKO, L.N. (1962) The isotopic composition of the elements in relation to problems concerning the genesis of ore deposits: Geol. Rudn. Mestorozhd. No. 2, 3-31
- (403) PICCIOTTO, E. (1962) Notes on isotope glaciology: Polar Record, v. 11, 206-208
- (404) PICCIOTTO, E., MAERE, X. de and FRIEDMAN, I. (1960) Isotopic composition and temperature of formation of Antarctic snows: Nature, v. 187, 857-859
- (405) POLYAKOV, YU.A. and GERMOCENOVA, N.S. (1961) Application of stable isotopes of hydrogen and oxygen in soil chemistry studies: Akad. Nauk Uz. S.S.R., v. 3, 467-470
- (406) POSEY, J.C. and SMITH, H.A. (1957) Equilibrium distribution of light and heavy waters in a freezing mixture: J. Am. Chem. Soc., v. 79, 555-557

OXYGEN
64

- (407) RAKESTRAW, N.M., RUDD, D.P. and DOLE, M. (1951) Isotopic composition of oxygen in air dissolved in Pacific Ocean Water as a function of depth: J. Am. Chem. Soc., v. 73, 2976
- (408) RANKAMA, K. (1954) Isotope Geology: McGraw-Hill (New York), 535 pp
- (409) RANKAMA, K. (1958) Geochemical applications of radioactivity and of stable isotopes: Cursillos y conf. Inst. "Lucas Mallada", v. 5, 3-15
- (410) RANKAMA, K. (1963) Progress in isotope geology: Interscience (New York) 705 pp
- (411) REES, A.L.G. (1941) Isotope exchange in inorganic chemistry: Ann. Repts. Prog. Chem., v. 38, 83-90
- (412) REID, A.F. and UREY, H.C. (1943) The use of the exchange between carbon dioxide, carbonic acid, bicarbonate ion and water for isotopic concentration: J. Chem. Phys., v. 11, 403-412
- (413) REITZ, O. (1939) Methods and results of the use of isotopes in chemistry: Z. Elektrochem., v. 45, 100-116
- (414) REUTER, J.H., EPSTEIN, S. and TAYLOR, H.P., Jr. (1964) O^{18}/O^{16} ratios of some chondritic meteorites and terrestrial ultramafic rocks: Amer. Geophys. Union 1964 Ann. Meet. Preprints, 16
- (415) RIESENLED, E.H. and CHANG, T.L. (1936) Vapor pressure, boiling point and heat of vaporization of HD₀ and H₂O¹⁸: C. Physik. Khem., v. B33, 127-132
- (416) RITTENBERG, D. and PONTICORVO, L. (1956) A method for the determination of the oxygen-18 concentration of the oxygen of organic compounds: Intern. J. Appl. Radiation and Isotopes, v. 1, 208-214
- (417) RITTENBERG, D. and PRICE, T.D. (1952) Stable isotopes in biochemical research: Ann. Rev. Nuclear Sci., v. 1, 569-596
- (418) ROAKE, W.E. and DOLE, M. (1950) Oxygen isotope exchange in the electric discharge: J. Am. Chem. Soc., v. 72, 36-40

OXYGEN

65

- (419) ROSHOLT, J.N., Jr., EMILIANI, C., GEISS, G., KOCZY, F.F., and WANGERSKY, P.J. (1962) $\text{Pa}^{231}/\text{Th}^{230}$ dating and $\text{O}^{18}/\text{O}^{16}$ temperature analysis of core A254-BR-C: *J. Geophys. Research*, v. 67, 2907-2911
- (420) ROTH, M. (1956) Analysis and preparation of stable isotopes: *Chim. Anal.*, v. 38, 3-14
- (421) RUBEN, S., RANDALL, M., KAMEN, M.D. and HYDE, J.L. (1941) Heavy oxygen (O^{18}) as a tracer study in the study of photosynthesis: *J. Am. Chem. Soc.*, v. 63, 877-879
- (422) RUECHARDT, E. (1930) The oxygen isotope, oxygen-18: *Naturwissenschaften*, v. 18, 534
- (423) SAKATA, S. and MORITA, N. (1956) Relative volatilities of waters containing heavy and light oxygen: *Bull. Chem. Soc. Japan*, v. 29, 284-285
- (424) SAKATA, S. and MORITA, N. (1957) Relative volatility of $\text{H}_2\text{O}^{16}/\text{H}_2\text{O}^{18}$ and equilibration time for fractional distillation of water: *Bull. Chem. Soc. Japan*, v. 30, 254-259
- (425) SAMOILOV, A. YA. (1955) Negative hydration of ions in aqueous solutions: *Doklady Akad. Nauk U.S.S.R.*, v. 102, 1173-1176
- (426) SAMUEL, D. and STECKEL, F. (1959) Bibliography of the stable isotopes of oxygen (O^{17} and O^{18}): *Pergamon Press*, 224 pp
- (427) SAMUEL, D. and WASSERMAN, I. (1964) Isotopic exchange of oxygen between alumina and organic compounds: *Chem. Ind.* 1964, 891
- (428) SANDSTRÖM, A.E. (1951) Concentration of heavy water in glacier ice: *Arkiv Fysik*, v. 3, 549-556
- (429) SAVEL'EV, B.A. (1962) Peculiarities in the composition of the glacial cover in the Antarctic: *Vestn. Mosk. Univ.*, Ser. IV, Geol., v. 17, 45-50
- (430) SAXENA, S.C. and BHATNAGAR, D.N. (1961) Enriching oxygen-18 by the chemical exchange of water and carbon dioxide: *J. Sci. Ind. Research (India)*, v. 20A, 316-318

- (431) SAXENA, S.C., BHATNAGAR, D.N. and RAMASWAMY, S. (1962) Partition function ratios and equilibrium constants for oxygen-18 exchange reactions: Jour. Chem. Eng. Data, v. 7, 240-242
- (432) SCHAEFFER, O.A. (1955) Effect of isotopic substitution on the mass spectra of molecules, III Carbon dioxide, theoretical interpretation: J. Chem. Phys., v. 23, 1309-1313
- (433) SCHAEFFER, O.A. and OWEN, H.R. (1955) Effect of isotopic substitution on the mass spectra of molecules II. Oxygen and carbon dioxide, experimental: J. Chem. Phys., v. 23, 1305-1309
- (434) SCHOLANDER, P.F., de VRIES, H., DANSGAARD, W., COACHMAN, L.K., NUTT, D.C. and HEMMINGSEN, E. (1962) Radiocarbon age and oxygen-18 content of Greenland icebergs: Medd. Groenland, v. 165, 1-26
- (435) SCHUMACHER, E. (1958) Storage of reagents and isotopic water in polyethylene flasks: Chimica, v. 12, 215-217
- (436) SCHWANDER, H. (1953) Determination of the relative oxygen isotope ratios in silicate rocks and minerals: Geochimica et Cosmochimica Acta, v. 4, 261-291
- (437) SCHWARCZ, H.P., CLAYTON, R.N. and MAYEDA, T.K. (1961) Oxygen isotope variations in metamorphosed calcareous rocks of New England: Geol. Soc. Amer. Spec. Paper 68, 265
- (438) SEMIOKHIN, I.A., ANDREEV, YU.P. and PANCHENKOV, G.M. (1963) Separation of O and C isotopes in dissociation of CO_2 in the silent electric discharge: Zh. Fiz. Khim., v. 37, 2782-2783
- (439) SEMIOKHIN, I.A., KOROVKIN, V.K., PANCHENKOV, G.M. and TUI, SHIH-CHUANG (1961) Separation of oxygen isotopes by the $\text{CO}_2\text{-H}_2\text{O}$ exchange in an electric discharge: Zhur. Fiz. Khim., v. 35, 1881-1883
- (440) SEMIOKHIN, I.A., PANCHENKOV, G.M. and KOROVKIN, V.K. (1963) Use of electrosynthesis of ozone for concentrating the rare O isotope O^{18} : Vestn. Mosk. Univer., Ser. II, Khim., v. 18, 29-32

- (441) SEMIOKHNIN, I.A., PANCHENKOV, G.M., KOROVKIN, V.K. and BORISOV, A.V. (1959) The separation of oxygen isotopes by electrical synthesis of ozone: Zhur. Fiz. Khim., v. 33, 1933-1938
- (442) SEMIOKHNIN, I.A., PANCHENKOV, G.M. and ZHUROV, YU. A. (1959) Use of isotope exchange between carbon dioxide and the carbonate ion to separate the isotopes of carbon and oxygen: Zhur. Fiz. Khim., v. 33, 2633-2635
- (443) SENFTLE, F.E. and BRACKEN, J.T. (1955) Theoretical effect of diffusion on isotope abundance ratios in rocks and associated fluids: Geochimica et Cosmochimica Acta, v. 7, 61-76
- (444) SHARP, R.P. and EPSTEIN, S. (1958) Oxygen-isotope ratios and glacier movement: in, Internat. Geod. Geophys. Union Assoc. Sci. Hydrology, Chamonix, 359-369
- (445) SHARP, R.P., EPSTEIN, S. and VIDZIUNAS, I. (1960) Oxygen isotope ratios in the Blue glacier, Olympic Mountains, Washington, U.S.A. J. Geophys. Research, v. 65, 4043-4059
- (446) SHATENSTEIN, A.I. and VARSHAVSKII, YA.M. (1956) Methods for isotopic analysis of water I. New application for measurement of density by a drop method: Zhur. Anal. Khim., v. 11, 746
- (447) SHATENSTEIN, A.I. and VARSHAVSKII, YA.M. (1957) Methods for isotopic analysis of water III The complete isotopic analysis of water by decomposing with iron: Zhur. Anal. Khim., v. 12, 236-239
- (448) SHATENSTEIN, A.I., YAKOVLEVA, E.A., GLADKOVA, E.N., SUZDALTSEVA, S.F. and ANTIPOVA, N.P. (1957) Methods for isotopic analysis of water II. New liquids for the drop method of the isotopic analysis of water with deuterium concentrations up to 100 atom percent: Zhur. Anal. Khim., v. 12, 115-117
- (449) SHATENSTEIN, A.I., YAKOVLEVA, E.A., GLADKOVA, E.N., SUZDALTSEVA, S.F. and ANTIPOVA, N.P. (1957) Methods for the isotopic analysis of water IV A method for complete isotopic analysis of water: Zhur. Anal. Khim., v. 12, 398-401
- (450) SHATENSTEIN, A.I. and ZVYAGINTSEVA, E.N. (1957) Methods for isotopic analysis of water. V. A float method for measuring density difference with an accuracy within 0.2 gamma: Zhur. Anal. Khim., v. 12, 516-522

OXYGEN
68

- (451) SILVERMAN, S.R. (1951) The isotope geology of oxygen:
Geochimica et Cosmochimica Acta, v. 2,
26-42
- (452) SKARRE, O.K. and BRODSKII, A.I. (1938) Concentration of
the heavy isotope of oxygen and the isotopic
analysis of water: *Compt. rend. acad. Sci.*
U.S.S.R., v. 20, 565-568
- (453) SMITH, E.R. (1934) A slight difference in the isotopic
composition of oxygen made by fractionating
of liquid air and oxygen of ordinary air:
J. Chem. Phys., v. 2, 298
- (454) SMITH, E.R. (1934) The isotopic fractionation of water
by physiological processes: *Science*, v. 79,
454-455
- (455) SMITH, E.R. and MATHESON, H. (1936) Difference in atomic
weight of oxygen from air and from water:
J. Research Natl. Bur. Standards (U.S.). v. 17,
625-628
- (456) SMYTHE, W.R. (1934) The isotope ratio in oxygen: *Phys.
Rev.*, v. 45, 299-303
- (457) SOROKIN, YU.I. (1959) Determination of isotope effect on
photosynthesis in *Scenedesmus quadricauda* cultures:
Akad. Nauk U.S.S.R., No. 4, 7-9
- (458) SPINDEL, W. and STERN, M.J. (1960) Atomic exchange in NO:
J. Chem. Phys., v. 32, 1579-1581
- (459) SPITSYN, V.I., AISTOVA, R.I. and VASIL'EV, V.N. (1955) The
oxygen isotope exchange between heavy oxygen
water and some tungstates: *Doklady Akad. Nauk
U.S.S.R.*, v. 104, 741-743
- (460) SPITSYN, V.I. and FINIKOV, V.G. (1956) Isotope exchange
between gaseous oxygen and alkali-metal
sulphates at high temperatures: *Doklady Akad.
Nauk U.S.S.R.*, v. 108, 491-494
- (461) SPITTLER, T.M. and HUSTON, J.L. (1964) New technique
for assay of oxygen-18 in sulfur dioxide:
Anal. Chem., v. 36, 575-577

- (462) STEIN, F.S. (1952) Measurement of isotope ratios for certain gases and their dissociation products: Dissertation Abstracts, v. 12, 205-206
- (463) STEVENS, R.H. (1957) Special application line-recorder mass spectrometer for isotope analysis: U.S. Atomic Energy Comm. K-1334, 23 pp.
- (464) SUESS, H.E. (1956) Absolute chronology of the last glaciation: Science, v. 123, 355-357
- (465) TAUBE, H. (1954) Use of oxygen isotope effects in the study of hydration of ions: J. Phys. Chem., v. 58, 523-528
- (466) TAUBE, H. (1956) Applications of oxygen isotopes in chemical studies: Ann. Rev. Nuclear Sci., No. 6, 277-302
- (467) TAYLOR, H.P., Jr. (1962) Oxygen isotope studies on the origin of tektites: J. Geophys. Research, v. 67, 4485-4490
- (468) TAYLOR, H.P., Jr. (1963) Isotopic evidence for large-scale oxygen exchange during metamorphism of Adirondack igneous rocks: Geol. Soc. Amer. Spec. Paper 76, 163-164
- (469) TAYLOR, H.P., Jr., ALBEE, A.L. and EPSTEIN, S. (1963) $\text{O}^{18}/\text{O}^{16}$ ratios of coexisting minerals in three assemblages of kyanite zone pelitic schist: J. Geophys. Research, v. 66, 2565-2566 (1961); J. Geol., v. 71, 513-522 (1963)
- (470) TAYLOR, H.P., Jr., DUKE, M.B. SILVER, L.T. and EPSTEIN, S. (1964) Oxygen isotopic studies of minerals in stony meteorites: Ann. Geophys. Union 1964 Ann. Meet. Preprints, 16
- (471) TAYLOR, H.P., Jr., and EPSTEIN, S. (1960) $\text{O}^{18}/\text{O}^{16}$ ratios in rocks and coexisting minerals of the Skaergaard intrusion of east Greenland: Bull. Geol. Soc. Amer., v. 71, 1989
- (472) TAYLOR, H.P., Jr. and EPSTEIN, S. (1960) $\text{O}^{18}/\text{O}^{16}$ ratios in coexisting minerals of igneous rocks: J. Geophys. Research, v. 65, 2528

OXYGEN

70

- (473) TAYLOR, H.P., Jr. and EPSTEIN, S. (1961) O^{18}/O^{16} ratios of feldspars and quartz in zoned granitic pegmatites: Geol. Soc. Amer. Spec. Paper 68, 283-284
- (474) TAYLOR, H.P., Jr. and EPSTEIN, S. (1962) Oxygen isotope studies on the origin of tektites: J. Geophys. Research, v. 67, 1659
- (475) TAYLOR, H.P., Jr. and EPSTEIN, S. (1962) Oxygen isotope studies on the origin of tektites: J. Geophys. Research, v. 67, 4485
- (476) TAYLOR, H.P., Jr. and EPSTEIN, S. (1962) Relation between O^{18}/O^{16} ratios in coexisting minerals of igneous and metamorphic rocks. I. Principles and experimental results: Bull. Geol. Soc. Amer., v. 73, 461-480
- (477) TAYLOR, H.P., Jr. and EPSTEIN, S. (1962) Relation between O^{18}/O^{16} ratios in coexisting minerals of igneous and metamorphic rocks II. Application to petrologic problems: Bull. Geol. Soc. Amer., v. 73, 675-693
- (478) TAYLOR, H.P., Jr. and EPSTEIN, S. (1963) Comparison of O^{18}/O^{16} ratios in tektites, soils and impactite glasses: Amer. Geophys. Union 1963 Ann. Meet. Preprints, 28
- (479) TAYLOR, H.P., Jr. and EPSTEIN, S. (1963) O^{18}/O^{16} ratios in rocks and coexisting minerals of the Skaergaard intrusion, East Greenland: Jour. Petrol., v. 4, 51-74
- (480) TAYLOR, H.P., Jr. and EPSTEIN, S. (1964) Comparison of oxygen isotope analyses of tektites, soils and impactite glasses: in, Cosmic and Isotopic Chemistry, ed. by H. Craig, S.L. Miller and C.J. Wasserburg, North Holland (Amsterdam), 181-199
- (481) TAYLOR, H.S., Jr. (1948) Uses of the separated stable isotopes of oxygen: Proc. Am. Phil. Soc., v. 92, 15

- (482) TAYLOR, H.S. and GOULD, A.J. (1934) Oxygen isotope separation by chemical reaction: *J. Am. Chem. Soc.*, v. 56, 1823
- (483) TAYLOR, T.I. (1963) Chemical exchange reactions for the concentration of nitrogen and oxygen isotopes: *J. Chim. Phys.*, v. 60, 154-159
- (484) TAYLOR, T.I. and BERNSTEIN, R.B. (1947) Enrichment of C¹³ and O¹⁸ by a countercurrent gaseous exchange process using thermal diffusion: *J. Am. Chem. Soc.*, v. 69, 2076
- (485) TAYLOR, T.I. and CLARKE, J.C. (1959) Exchange of nitric acid solutions as a means of concentrating oxygen-18: *J. Chem. Phys.*, v. 31, 277-278
- (486) TEIS, R.V. (1939) Isotopic composition of rain water: *Compt. Rend. Acad. Sci. U.S.S.R.*, v. 23, 674-678
- (487) TEIS, R.V. (1939) Isotopic composition of water from some rivers and lakes of the USSR: *Compt. Rend. Acad. Sci. U.S.S.R.*, v. 24, 779-782
- (488) TEIS, R.V. (1946) Isotopic composition of mineral waters: *Compt. Rend. Acad. Sci. U.S.S.R.*, v. 53, 135-137
- (489) TEIS, R.V. (1948) Isotopic composition of fossil ices: *Doklady Akad. Nauk U.S.S.R.*, v. 62, 365-367
- (490) TEIS, R.V. (1950) Isotopic composition of the oxygen of carbonates and its temperature dependence: *Doklady Akad. Nauk U.S.S.R.*, v. 72, 73-76
- (491) TEIS, R.V. (1950) Isotopic composition of the oxygen of organic compounds of vegetable origin: *Doklady Akad. Nauk U.S.S.R.*, v. 72, 351-353
- (492) TEIS, R.V. (1951) Isotopic method for the determination of the formation temperatures of carbonate minerals: *Doklady Akad. Nauk U.S.S.R.*, v. 79, 291-294
- (493) TEIS, R.V. (1954) The isotopic composition of waters of crystallization: *Doklady Akad. Nauk U.S.S.R.*, v. 99, 585-588

- (494) TEIS, R.V. (1954) The isotopic composition of waters of crystallization: Doklady Akad. Nauk U.S.S.R., v. 99, 585-588
- (495) TEIS, R.V. (1955) The method of isotopic paleothermometry: Uspekhi Khim., v. 24, 163-180
- (496) TEIS, R.V. (1956) The isotopic composition of the oxygen of natural sulfates: Geokhimiya, 1956, No. 3, 28-32
- (497) TEIS, R.V., CHUPAKHIN, M.S. and NAIDIN, D.P. (1957) Determination of paleotemperatures from the isotopic composition of oxygen in the calcite of shells of some Cretaceous fossils of the Crimea: Geokhimiya, 1957, 271-276
- (498) TEIS, R.V. and FLORENSKII, K.P. (1940) Isotopic composition of snow: Comp. Rend. Acad. Sci., U.S.S.R., v. 28, 70-74
- (499) TEIS, R.V. and FLORENSKII, K.P. (1941) Distribution of isotopes of hydrogen and oxygen during the freezing of water: Compt. Rend. Acad. Sci., U.S.S.R., v. 32, 199-202
- (500) TEIS, R.V. and FLORENSKII, K.P. (1945) Isotopic composition of the waters of Upper Svanetian glaciers: Compt. Rend. Acad. Sci. U.S.S.R., v. 47, 640-641; Doklady Akad. Nauk U.S.S.R., v. 47, 666-667
- (501) TEIS, R.V., GROMOVA, T.S. and KOCHETKOVA, S.N. (1958) The isotopic composition of natural phosphates: Doklady Akad. Nauk U.S.S.R., v. 122, 1057-1060
- (502) THODE, H.G. and GRAMAH, R.L. (1947) Isotope abundance measurements: Proc. Intern. Congr. Pure and Applied Chem. (London), v.11, 627-636
- (503) THODE, H.G., SMITH, S.R. and WALKING, F.O. (1944) The separation of the oxygen isotopes by the distillation of water: Can. J. Research, v. 22B, 127-136
- (504) THÜRKAUF, M., NARTEN, A. and KUHN, W. (1960) Separation and concentration pattern for oxygen isotopes O^{16} , O^{17} and O^{18} in the distillation of water in a precision distillation apparatus: Helv. Chim. Acta, v. 43, 989-1004
- (505) TIKHOMIROV, I.A. and MELENEVSKII, V.N. (1962) Isotope effect in thermal decomposition of ozone: Izv. Sibirsk. Otd. Akad. Nauk U.S.S.R., 1962 No. 12, 131-133

- (506) TIKHOMIROV, M.V. and TUNITSKII, N.N. (1959) Separation of carbon and oxygen isotopes by rectification of carbon monoxide in a 12-meter column: *Zhur. Priklad. Khim.*, v. 32, 531-536
- (507) TITANI, T. (1940) Application of heavy hydrogen and heavy oxygen in chemical investigations: *Chem. Rev. (Japan)*, v. 6, 12-26
- (508) TITANI, T. and GOTO, K. (1938) Exchange reaction of the oxygen atom between a few inorganic anions and water: *Bull. Chem. Soc. Japan*, v. 13, 667-668
- (509) TITANI, T. and GOTO, K. (1938) Exchange reaction of the oxygen atom between a few inorganic anions and water: *Bull. Chem. Soc. Japan*, v. 14, 77-85
- (510) TITANI, T., MORITA, N. and GOTO, K. (1938) Exchange reaction of oxygen atom between carbonate ion and water: *Bull. Chem. Soc. Japan*, v. 13, 329-330
- (511) TOKUDA, T. (1955) Genesis of vein quartz in quartzite: *Kagaku*, v. 25, 582-583
- (512) TOKUDA, T. (1956) Geological origin of veined quartz in Akashiro- and Aoshiro-Keiseki (breccial quartz stones) in Japan: *Mem. Inst. Sci. and Ind. Research, Osaka Univ.*, v. 13, 165-169; *Chem. Zentr.*, v. 129, 1796 (1958)
- (513) TOKUDA, T. (1959) Comparative studies on quartz of contrasted origin in Japan: *Mem. Inst. Sci. Ind. Research, Osaka Univ.*, v. 16, 189-196
- (514) TOKUDA, T. and AO, T. (1956) Abundance ratio of oxygen isotopes in siliceous rocks: *Yogyo Kyokaishi*, v. 64, 12-18
- (515) TOKUDA, T. and KASHIDA, T. (1950) Atomic weight of oxygen in natural minerals II. Metamorphic silicate minerals: *Collected papers Fac. Sci. Osaka Univ.*, v. 11, 1-2
- (516) TROFIMOV, A.V. (1953) Carbonate procedure for mass-spectrographic analysis of oxygen in water: *Zhur. Anal. Khim.*, v. 8, 353-355
- (517) TROFIMOV, A.V. (1954) The oxygen exchange of carbonate. Exchange with the gases oxygen and carbon dioxide: *Doklady Akad. Nauk U.S.S.R.*, v. 96, 335-338

OXYGEN

74

- (518) TROFIMOV, A.V. (1954) The oxygen exchange of carbonate. Exchange with the gases oxygen and carbon dioxide: Doklady Akad. Nauk U.S.S.R., v. 96, 335-338
- (519) TROFIMOV, A.V. (1954) The exchange and the geological retention of oxygen of solid carbonates in aqueous solutions: Doklady Akad. Nauk U.S.S.R., v. 98, 237-240
- (520) TUDGE, A.P. (1960) A method of analysis of oxygen isotopes in orthophosphate - its use in the measurement of paleotemperatures: Geochimica et Cosmochimica Acta, v. 18, 81-93
- (521) UBBELOHDE, A.R. (1948) The freezing-in of nuclear equilibrium: Proc. Phys. Soc. (London), v. 61, 96-97
- (522) UBISCH, H. v. (1949) The mass spectrometer and its use: I. Fra Fysik. Verden, No. 3, 170-178; II. Ibid. No. 4, 229-241
- (523) UKLONSKII, A.S. (1953) Preliminary investigations of the isotopic composition of surface and subterranean waters of Uzbekistan: Zapiski Uzbek. Otdel. Vsesoyuz. Mineral. Obshchestva 1953, No. 4, 47-62
- (524) ULUBEKOVA, M.V. (1957) Isotopic composition of cells of algae in photosynthesis: Doklady Akad. Nauk U.S.S.R., v. 112, 772-773
- (525) UREY, H.C. (1940) Separation of isotopes by chemical means: J. Wash. Acad. Sci., v. 30, 277-294
- (526) UREY, H.C. (1947) Thermodynamic properties of isotopic substances: J. Chem. Soc., 1947, 562-581
- (527) UREY, H.C. (1948) Oxygen isotopes in nature and in the laboratory: Science, v. 108, 489-496
- (528) UREY, H.C. (1953) The measurement of paleotemperatures: Proc. Conf. Nuclear Processes in Geol. Settings, Univ. Chicago, Natl. Research Council-Natl. Science Foundation 1953, 71-72
- (529) UREY, H.C. and GREIFF, L.J. (1935) Isotope exchange equilibria: J. Am. Chem. Soc., v. 57, 321-327

OXYGEN
75

- (530) UREY, H.C., MILLS, G.A., ROBERTS, I., THODE, H.G. and HUFFMAN, J.R. (1939) Vapor pressure and exchange constants of isotopic compounds: *J. Chem. Phys.*, v. 7, 138
- (531) UREY, H.C., LOWENSTAM, H.A., EPSTEIN, S. and MCKINNEY, C.R. (1951) Measurement of paleotemperatures and temperatures of the Upper Cretaceous of England Denmark and the southeastern United States: *Bull. Geol. Soc. Amer.*, v. 62, 399-416
- (532) UREY, H.C., PEGRAM, G.B. and HUFFMAN, J.R. (1936) Concentration of the oxygen isotopes: *J. Chem. Phys.*, v. 4, 623
- (533) VAINSHTEIN, F.M. and TUROVSKII, G. YA. (1950) Isotopic study of the mechanism of the oxidation of carbon monoxide on manganese dioxide: *Doklady Akad. Nauk U.S.S.R.*, v. 72, 297-299
- (534) VALENTINE, J.W. and MEADE, R.F. (1961) Californian Pleistocene paleotemperatures: *Calif. Univ. Pub. Geol. Sci.*, v. 40, 1-45
- (535) VARTAPETYAN, B.B. (1956) Study of chemistry of biological oxidation in plants with application of oxygen-18: *Akad. Nauk U.S.S.R.*, v. 9, 124-128
- (536) VARTAPETYAN, B.B. (1960) Participation of H_2O^{18} in metabolism of photosynthesizing tissue: *Fiziol. Rastenii*, Akad. Nauk U.S.S.R., v. 7, 414-418
- (537) VARTAPETYAN, B.B. and KURSANOV, A.L. (1959) Water metabolism investigated by use of water- O^{18} : *Fiziol. Rastenii*, Akad. Nauk U.S.S.R., v. 6, 144-149
- (538) VEDDER, R. (1960) Isotope analysis in geological samples for O^{18} and C^{13} : *Kernenergie*, v. 3, 890-892
- (539) VERNADSKII, V.I., VINOGRADOV, A.P. and TEIS, R.V. (1941) Determination of the isotopic composition of waters in metamorphic rocks and minerals: *Compt. Rend. Acad. Sci. U.S.S.R.*, v. 31, 573-576
- (540) VINOGRADOV, A.P. (1947) Geochemical history of oxygen and photosynthesis: *Izvest. Akad. Nauk U.S.S.R.*, 1947, 409-422

OXYGEN
76

- (541) VINOGRADOV, A.P. (1954) Geochemistry of isotopes: Vestnik Akad. Nauk U.S.S.R., v. 24, No. 5, 26-43
- (542) VINOGRADOV, A.P. (1957) Isotope relations in magmatic rocks as applied to the problem of the genesis of rocks of the earth crust: Trudy Geokhim. Simpoziuma, Moscow, 120-130
- (543) VINOGRADOV, A.P. (1959) Geochemistry of isotopes: Internat. Geol. Rev., 1, 1-13
- (544) VINOGRADOV, A.P. and DONTSOVA, E.I. (1947) Isotopic composition of oxygen of some minerals: Doklady Akad. Nauk U.S.S.R., v. 56, 391-392
- (545) VINOGRADOV, A.P. and DONTSOVA, E.I. (1947) Isotopic composition of oxygen in aluminosilicates of mineral deposits: Doklady Akad. Nauk U.S.S.R., v. 58, 83-84
- (546) VINOGRADOV, A.P. and DONTSOVA, E.I. (1952) Isotopic composition of oxygen in minerals of skarn origin: Doklady Akad. Nauk U.S.S.R., v. 85, 1341-1343
- (547) VINOGRADOV, A.P., DONTSOVA, E.I. and CHUPAKHIN, M.S. (1958) Isotopic composition of oxygen in igneous rocks and meteorites: Geokhimiya, 1958, 187-190
- (548) VINOGRADOV, A.P., DONTSOVA, E.I. and CHUPAKHIN, M.S. (1960) Isotopic ratios of oxygen in meteorites and igneous rocks: Geochimica et Cosmochimica Acta, v. 18, 278-293
- (549) VINOGRADOV, A.P., KUTYURIN, V.M., ULUBEKOVA, M.V. and ZADOROZHNYI, I.K. (1959) Isotopic composition of photosynthesis oxygen: Doklady Akad. Nauk U.S.S.R., v. 125, 1151-1153
- (550) VINOGRADOV, A.P., KUTYURIN, V.M., ULEBEKOVA, M.V. and ZADOROZHNYI, I.K. (1960) Isotope composition of oxygen in photosynthesis and respiration: Doklady Akad. Nauk U.S.S.R., v. 134, 1486-1489

OXYGEN
77

- (551) VINOGRADOV, A.P., KUTYURIN, V.M. and ZADOROZHNYI, I.K.
(1959) Fractionation of isotopes of atmospheric oxygen: Geokhimiya (1959), 195-205
- (552) VINOGRADOV, A.P. and TEIS, R.V. (1941) Isotopic composition of oxygen of different origins: Compt. Rend. Acad. Sci. U.S.S.R., v. 33, 490-493
- (553) VINOGRADOV, A.P. and TEIS, R.V. (1947) Determination of the isotopic composition of oxygen due to photosynthesis: Compt. Rend. Acad. Sci. U.S.S.R., v. 56, 59-60
- (554) VOJTA, G. (1961) Statistical thermodynamics of ideal gases with isotope-substituted molecules: Zeit. Physik. Chem., v. 217, 337-352
- (555) VUL'FSON, V.I. (1957) Use of radioactive atoms in hydrometerological and hydrochemical investigations: Vysshee Inzh. Morskoe Uchilische, 1957, No. 6, 9-18
- (556) WAHL, M.H. and UREY, H.C. (1935) Vapor pressure of the isotopic forms of water: J. Chem. Phys., v. 3, 411-414
- (557) WALCHER, W. (1957) Production and measurement of isotopes: Naturwissenschaften, v. 44, 132-444
- (558) WANG, J.H. (1951) Self-diffusion and structure of liquid water II. Measurement of self-diffusion of liquid water with O^{18} as tracer: J. Am. Chem. Soc., v. 73, 4181-4183
- (559) WANG, J.H., ROBINSON, C.V. and EDELMAN, I.S. (1952) Self diffusion and structure of liquid water III. Measurement of the self diffusion of liquid water with hydrogen², hydrogen³ and oxygen¹⁸ as tracers: J. Am. Chem. Soc., v. 75, 466-470
- (560) WANLESS, R.K. (1957) Application of isotopic studies to geological problems: Can. Min. J., v. 78, 133-136
- (561) WERSHAW, R.L. (1964) Oxygen isotope fractionation in the system quartz-water: Dissertation Abst., v. 24, No. 12
- (562) WASHBURN, H.W., BERRY, C.E. and HALL, L.G. (1953) Instrumental problems encountered in mass-spectrometer isotope analysis of water samples: Natl. Bur. Standards (U.S.) Circ. #522, 141-149

OXYGEN
78

- (563) WATSON, H.E. (1954) The refractive indices of aqueous solutions of H_2O^{18} and CO_2 : J. Chem. Soc., v. 76, 5884-5886
- (564) WEBB, A.N. and EISCHENS, R.P. (1955) Oxygen exchange in chemisorbed carbon monoxide: J. Am. Chem. Soc., v. 77, 4710-4713
- (565) WEBER, J.N. (1964) Oxygen isotope ratios in freshwater limestones as sensitive paleoclimatic temperature indicators. 1st Joint Intern. Meet. Amer. Assoc. Petrol. Geol., Soc. Econ. Pal. Min., Geol. Assoc. Can., Min. Assoc. Can. Preprints, 551
- (566) WEBER, J.N. and KEITH, M.L. (1962) Isotopic composition and environmental classification of selected limestones and fossils: Geol. Soc. Amer. 1962 Ann. Meet. Preprints, 159A-160A
- (567) WEBER, J.N. and LA ROCQUE, A. (1963) Isotope ratios in marine mollusk shells after prolonged contact with flowing freshwater: Science, v. 142, 1666
- (568) WEBSTER, L.A., WAHL, M.H. and UREY, H.C. (1935) Fractionation of the oxygen isotopes in an exchange reaction: J. Chem. Phys., v. 3, 129
- (569) WEI, YUNG-KANG and BERNSTEIN, R.B. (1959) Deuterium exchange between water and boehmite (alpha alumina monohydrate). Activation energy for proton diffusion in boehmite: J. Phys. Chem., v. 63, 738-741
- (570) WETZEL, K. and KRETZSCHMANN, G. (1960) Separation and use of the stable isotopes, I. Separation of stable isotopes by chemical exchange: Chem. Tech., v. 12, 263-266
- (571) WHITE, D.E. and CRAIG, H. (1959) Isotope geology of the Steamboat Springs area, Nevada: Bull. Geol. Soc. Amer., v. 70, 1696
- (572) WINTER, E.R.S. (1950) The exchange reactions of solid oxides. I. J. Chem. Soc. 1950, 1170-1175; II. Ibid., 1175-1177
- (573) WINTER, E.R.S. (1955) Exchange reactions of solid oxides VI. The reactions of carbon monoxide, carbon dioxide and oxygen on cuprous oxide, nickel oxide and chromium oxide: J. Chem. Soc., (1955) 2726-2740

OXYGEN
79

- (574) WINTER, E.R.S. and HOUGHTON, G. (1950) The exchange of oxygen-18 between oxygen gas and certain metallic oxides: Mass Spectrometry, (London), 1950, 127-140
- (575) WISEMAN, J.D.H. (1954) The determination and significance of past temperature changes in the upper layer of the equatorial Atlantic Ocean: Proc. Roy. Soc. (London), A222, 296-323
- (576) WISEMAN, J.D.H. (1959) The relationship between paleo-temperatures and carbonate content in a deep-sea core: A discussion; J. Geology, v. 67, 572-573
- (577) YALKOVSKY, R. (1957) The relationship between paleotemperature and carbonate content in a deep-sea core: J. Geology, v. 65, 480-496
- (578) YALKOVSKY, R. (1959) The relationship between paleotemperatures and carbonate content in a deep-sea core: A reply: J. Geology, v. 67, 574-577
- (579) YALMAN, R.G., CORWIN, J.J., OWEN, G.E. and FETTER, N. (1955) Oxygen exchange in the hydrothermal growth of quartz: J. Am. Chem. Soc., v. 77, 4779-4780
- (580) YEATTS, L.B., Jr. (1958) Fractionation of nitrogen and oxygen isotopes between gaseous nitric oxide and liquid nitrosyl chloride: J. Chem. Phys., v. 28, 1255
- (581) YOSHIDA, Y., MORITA, N., TAMIYA, H., NAKAYAMA, H. and HUJISHIGE, H. (1942) Content of heavy isotope in assimilated oxygen - the mechanism of photosynthesis: Acta Phytochim. (Japan), v. 13, 11-18

ADDENDUM

80

- (1) KAPLIN, I.R. and RITTENBERG, S.C. (1964) Carbon isotope fractionation during metabolism of lactate by *Desulfovibrio desulfuricans*: *J. Gen. Microbiol.*, v. 34, 213-217
- (2) KEELING, C.D. (1957) Variations in concentration and isotopic abundances of atmospheric carbon dioxide: *Proc. Conf. Recent Research in Climatology*, La Jolla, Calif. Ed. by H. Craig. Comm. Research Water Resources, Univ. Calif., 43-49
- (3) PARKER, P.L. (1964) The biogeochemistry of the stable isotopes of carbon in a marine bay: *Geochim. et Cosmochim. Acta*, v. 28, 1155-1164
- (4) WEBER, J.N. (1964) Carbon-oxygen isotopic composition of Flagstaff carbonate rocks and its bearing on the history of Paleocene-Eocene Lake Flagstaff of central Utah: *Geochim. et Cosmochim. Acta*, v. 28, 1219-1242
- (5) WEBER, J.N. (1964) Carbon isotope ratios in dolostones: some implications concerning the genesis of secondary and "primary" dolostones: *Geochim. et Cosmochim. Acta*, v. 28, 1257-1265
- (6) WOOD, A. (1964) Carbon isotope effects in the decarboxylation of oxaloacetic acid, I. Studies using Cl¹³: *Trans. Faraday Soc.*, v. 60, 1263-1267