Crown Point Area, New Mexico

4:20 J. L. RIDGLEY: Roll-Type Uranium Occurrence at Dennison-Bunn Claim and Possibility of Uranium Deposits in Eastern Part of San Juan Basin, New Mexico

4:40 R. R. RAWSON: Uranium in Todilto Limestone—Sabkha-Like Deposit

Wednesday, May 16, 1979

8:30 R. H. DE VOTO, R. H. MEAD: Use of Helium in Uranium Exploration, Grants District, New Mexico

8:50 H. M. BIVENS ET AL: Direct Measurement of Uranium by Prompt Fission Neutron Method of Pulsed Neutron Borehole Logging

9:10 D. L. HAYSLIP ET AL: Thermoluminescence of Uranium Host Rocks in Ambrosia Lake Area

9:30 D. D. RUNNELLS ET AL: Computer Modeling as Applied to Hydrochemical Exploration in Solution Mining

9:50 R. L. FLEISCHER, A. MOGRO-CAMPERO: Radon Emanation Over Orebody: Has Long-Distance Transport of Radon Been Observed?

10:10 Break

10:30 W. D. CONINE: In-Situ Uranium Leaching—Comparison of New Mexico with South Texas

10:50 J. W. MELVIN: Uranium Royalties and Severance Taxes in Grants Region—Effect on Minimum Producible Grade

11:10 D. G. BROOKINS: Mechanisms for Uranium Deposition in Grants Mineral Belt

11:30 F. F. LANGFORD: Stratigraphic Control of Uranium Deposits

ABSTRACTS OF PAPERS

AUSTIN, S. R., Bendix Field Engineering Corp., Grand Junction, Colo.

Dissolution and Authigenesis in Host Sandstones

Empty or partly empty shells that conform to detrital rather than original crystal shapes of sanidine grains are present in host sandstones of the Morrison Formation. This somewhat paradoxical situation is explained by removal of sodium from a surface layer of the detrital grain during weathering, with concomitant conversion of this layer to microcline, which resists dissolution under conditions prevailing after sedimentation. During compaction, dissolution of this outer layer occurs at pressure points; once this layer is penetrated, dissolution of the interior proceeds along crystallographic directions and removes all or part of the unaltered sanidine.

Untwinned microcline also is present as minute crystals within shells and as outgrowths on both detrital potash feldspar grains and (rarely) on the shells. Uraniferous organic material occurs both under and over some outgrowths on detrital microcline, suggesting contemporaneity of outgrowths and organic material. Elsewhere, chlorite, reportedly contemporaneous with coffinite, coats both exteriors and interiors of feldspar shells and thus succeeds feldspar dissolution; calcite supersedes rather than replaces feldspars. Quartz outgrowths are commonly earlier than uraniferous organic material but later than jordisite. Locally, chlorite and/or hematite form total or partial pseudomorphs after pyrite. Rarely, marcasite is partially pseudomorphous after, and forms outgrowths on, pyrite.

These and similar observations by others reveal fragments of a paragenetic sequence complicated by the presence of both primary and redistributed ore. Further investigations may complete a sequence useful in determining conditions of mineralization, and thus in the discovery of similar ore deposits.

BIVENS, HUGH M., DAL H. JENSEN, RALSTON W. BARNARD, and WILLIAM A. STEPHENSON, Sandia Laboratories, Albuquerque, N. M.

Direct Measurement of Uranium by Prompt Fission Neutron Method of Pulsed Neutron Borehole Logging

The capability provided by neutron logging techniques for the direct measurement of uranium is extremely valuable, especially in low-grade uranium mineralization not in equilibrium. Sandia Laboratories is developing one of these techniques which is based on the detection of epithermal prompt fission neutrons that result from the irradiation of uranium by 14 MeV neutrons from a pulsed neutron generator. A 70-mm O.D. development-model logging probe has been used in a limited field evaluation of the prompt fission neutron method of logging. From this evaluation has evolved a prototype logging probe and the basis for log interpretation. Additional logs required for interpretation are a caliper log and a density log. Additional probe development is under way including a neutron generator with a neutron output greater than 10^9 n/s. A vendor is being developed as a commercial source for the neutron generator. A definition of the interim logging system has been released and the system eventually developed will be defined in the open literature.

BROOKINS, D. G., Univ. New Mexico, Albuquerque, N. M.

Mechanisms for Uranium Deposition in Grants Mineral Belt

A polygenetic model for uranium deposition of much of the ore in the Grants mineral belt results from (a) spatial relations of orebodies, (b) geochronologic studies, (c) clay-mineral studies, (d) trace-element studies, and (e) theoretical considerations. Trend ore apparently formed from southeast-flowing solutions entirely in reduced ground with organic carbon (plus some hydrogen sulfide) acting as reductant; this is supported by evidence for organic carbon in calcite penecontemporaneous with ore, trace-element distribution, and other factors. Uplift, remobilization, and reprecipitation of some of the stratigraphically high ore in the Laguna district is somewhat similar to Wyoming roll-type deposits in terms of mineralization control by sulfide-sulfate equilibria and clay-mineralogic variations. The effect of this event is not apparent in the deeper Ambrosia Lake ore. The Laramide orogeny resulted in the establishment of a redox front which, in turn, resulted in destruction and remobilization of some earlier trend ore and the formation of stack ore. Virtually all zones of rock weakness are subjected to some mineralization near this front, and the sulfide-sulfate equilibria cause many of these stack deposits to resemble roll fronts. Roll geometry of some of this ore is due to encroachment of the front on reduced ground after the Laramide. Younger, but very local, solutions result in ore in oxidized ground, some of which is indicated by primary uranophane. Roll geometry is present for some of these deposits. The superimposition of the redox front on the older trend ore allows both carbon and sulfur to act as reductants, and orebody geometries are similar to Wyoming-type rolls in terms of uranium distribution but not necessarily for trace-element distribution.

BROOKINS, D. G., Univ. New Mexico, Albuquerque, N. M.

Periods of Mineralization in Grants Mineral Belt, New Mexico

Geologic observations coupled with laboratory studies indicate several periods of mineralization in the Grants mineral belt. The earliest mineralization is from trend ore in the Ambrosia Lake and Smith Lake districts; Rb-Sr radiometric ages on chlorite formed penecontemporaneously with primary uranium minerals range from 135 to 138 ± 8 m.y. This period of mineralization is within the limits of error for the age of sedimentation obtained on barren ground montmorillonite of 140 to 145 ± 10 m.y., but cross-cutting ore indicates early epigenetic as opposed to syngenetic mineralization. Early formed ore in the Laguna district was remobilized and reprecipitated during some mid-Cretaceous event at 110 to 115 m.y. determined on the basis of Rb-Sr dating. Ore was not derived from the overlying Dakota Formation (Cretaceous), as the Rb-Sr dates for the Dakota and Mancos formations are 92 ± 6 m.y. and 85 ± 10 m.y., respectively (in excellent agreement with U.S. Geological Survey K-Ar dating). Mineralization is present in the Dakota Sandstone, but whether the ore was syngenetic or epigenetic is unknown. Much of the stack ore was apparently formed during the Laramide orogeny about 60 m.y. ago, usually in close proximity to a redox front. Post-Laramide ore is proposed for several deposits in reduced ground at this redox front, some of which is apparently Tertiary although remobilized Jurassic ore cannot be distinguished from that from much younger sources even though reworked Jurassic ore is supported by high $^{87}Sr/^{86}Sr$ ratios. Ore possibly formed during the Tertiary from a southerly source for some deposits, and some remobilized ore, possibly of Pleistocene age, is common in minor amounts.

CHENOWETH, WILLIAM L., U.S. Dept. Energy, Grand Junction, Colo.

Exploration in Grants Uranium Region Since 1963

The Grants uranium region is the largest uranium area in the United States. From 1951 through 1977, underground and open-pit mines produced 126,537 tons of uranium oxide U_3O_8. This amounts to 40% of the total United States uranium production. Ore reserves estimated by DOE for the region are 366,200 tons U_3O_8, or 53% of the domestic reserves in the $30 forward-cost category. Since 1963, production in the Grants uranium region has expanded to the north and east largely owing to the efforts of exploration programs of major oil companies. During this period, average drilling depths have increased from approximately 200 to nearly 1,600 ft (60 to 960 m). Application of various geologic models is expected to assist in finding additional deposits, and the Grants uranium region is expected to maintain its position as the nation's principal source of uranium for years.

DELLA VALLE, R. S., and D. G. BROOKINS, Univ. New Mexico, Albuquerque, N. M.

Geochemical Studies of Grants Mineral Belt, New Mexico

Several hundred clay mineral and whole rock samples of ores and barren rocks from the Grants mineral belt have been analyzed by instrumental neutron activation analysis (INAA) and delayed neutron activation analysis (DNAA). The DNAA method allows high precision and accuracy for uranium and thorium determination, whereas the INAA method allows determination of 20 to 30 trace elements. The trace-element data can only be interpreted properly if the clay-mineral (-2μ) fraction is compared directly with whole-rock samples. The INAA data support mineralization of trend ore as due to southeast-flowing solutions; the DNAA determination of uranium suggests that the source of uranium in the Westwater Canyon Member of the Jurassic was not from the overlying Brushy Basin Formation. Local zonation of trace elements, especially the rare earth elements (REE), indicates fixation of many trace elements when uranium mineralization occurred. Thus, REE-depleted, oxidized ground can, with caution, be used for exploration purposes. Vanadium originally precipitated as V^{3+} in chlorites remains in the original sites after oxidation to V^{5+} and is thus also valuable as a pathfinder. Data for antimony suggest that it, too, may be useful. In general, trend-ore deposits are characterized by a high chlorite + illite, illite + illite-montmorillonite, or illite + chlorite + illite-montmorillonite, whereas ore near the redox front may contain primary kaolinite. The REE are concentrated greatly in all types of ore, primary or secondary, and, coupled with uranium haloes, are useful as ore guides.

FALKOWSKI, S. K., New Mexico Inst. Mining & Technology, Socorro, N. M.

Geology and Ore Deposits of Johnny M Mine, Ambrosia Lake District, New Mexico

The Johnny M mine is one of very few mines in the Ambrosia Lake district with uranium ore in two members of the Jurassic Morrison Formation; these members are the Westwater Canyon sandstone and the Brushy Basin shale. The Westwater Canyon ore is contained in the two upper sandstone units of the member, and the Brushy Basin ore is contained in the Poison Canyon sandstone.

The sedimentary features and structures in the Westwater Canyon sandstone indicate that the sediments