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Geology of Shely Cauldron, Pinto Canyon Area, Presidio County, Texas

The Shely cauldron is in southwestern Presidio County, Texas, in an area known as Pinto Canyon. The Shely Volcanic Group is an Oligocene volcanic sequence of rhyolite and trachyte ash-flow tuffs, lava flows, and volcaniclastic sediments and agglomerates. It represents an intracauldron facies which filled a collapse zone after the initial cauldron-forming eruptions (upper Colmena Tuff, Buckshot Ignimbrite, and lower Chambers Tuff).

The Allen intrusive complex represents a series of discontinuous early rhyolite porphyry domes and dikes related to the resurgence of the central cauldron block (previously known as the Loma Plata anticline), and a late nonporphyritic rhyolite flow dome associated with the final emplacement of a discontinuous ring dike along the outer margins of the ring-fracture zone.

The occurrence of economic mineralization associated with late-stage hydrothermal mineralization within the Shely caldera is highly probable considering the silicic nature of the late-stage rhyolite intrusions (e.g., the uranium at Organ Pipe Hill; fluorite at the Bienevides Ranch; lead, zinc, and silver mineralization at the abandoned Loma Plata mine; and molybdenum mineralization at the French Ranch).

Recently a great deal of interest has been shown in the anomalous uranium values found at Organ Pipe Hill. Several shallow exploratory holes were drilled but failed to detect any uranium of economic interest.

Analysis of the uranium mineralization at Organ Pipe Hill (an early rhyolite porphyry intrusion of the Allen complex) suggests that the uranium was leached from younger Allen volcanic units and deposited along fractures developed subsequent to the intrusive emplacement. I believe that hydrothermal convection cells associated with the emplacement of an adjacent nonporphyritic rhyolite flow dome and associated ash-flow tuffs (an offshoot of the major late stage ring dike emplacement) was the major contributing factor in the uranium concentrations at Organ Pipe Hill. Additional trace-element and geochemical analysis is still in progress.

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Leonardian Radiolarians from Delaware Basin

A diverse assemblage of spumellarine radiolarians has been recovered from a sample of the Bone Springs Limestone (Leonardian) in the southern Guadalupe Mountains of west Texas. Other Permian radiolarian assemblages in North America include King's as yet undescribed assemblages from the Glass Mountains and assemblages from the Hegler and Lamar Limestone Members of the Bell Canyon Formation (Guadalupian). As no other certain Permian radiolarian assemblages are known worldwide, these west Texas faunas have much evolutionary and biostratigraphic significance. The Bone Springs fauna includes representatives of at least 15 genera, but taxonomic study is incomplete.

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Volcanogenic Uranium Deposits Associated with Mount Belknap Volcanics, Marysvale Volcanic Field, West-Central Utah

The Marysvale volcanic field consists of two contrasting assemblages of rocks, an older calc-alkalic assemblage erupted between 35 and 21 m.y. ago from coalescing volcanoes, and a younger bimodal basalt-rhyolite assemblage of heterogeneous lava flows and ash-flow tuffs erupted throughout later Cenozoic time. The Mount Belknap Volcanics, 21 to 16 m.y. old, are the largest accumulation of alkali rhyolite in the bimodal assemblage; they were erupted concurrently from two source areas about 21 km apart in and just east of the northern Tushar Mountains. Products from the two source areas intertongue complexly. The Mount Belknap magma was anomalously radioactive, and vitrophyres from several different localities average about 14 ppm U. Most of the known uranium deposits and occurrences in the Marysvale volcanic field are associated with the Mount Belknap Volcanics.

Uranium deposits associated closely with igneous centers are epitomized by the hydrothermal uranium-molybdenum-bearing veins in the Central mining area, 6 km north of Marysvale, in the eastern source area of the Mount Belknap Volcanics. The veins are localized in a small area of highly fractured ground believed to mark the surface expression above a hidden intrusive that potentially may host a porphyry-molybdenum deposit. Fluorine-rich hydrothermal fluids at 150°C and having low pH and f_{O_2} permeated the broken rocks. At the deepest levels exposed, the fluids and wall rocks interacted to form kaolinitic alteration products and to deposit uraninite, coffinite, jordisite, molybdenite, umhoite, fluorite, quartz, and pyrite in open fractures. The fluids were progressively oxidized at higher levels, and sooty pitchblende and fluorite were the predominant vein minerals deposited. In the highly oxidizing environment at the top of the system, uranium phosphate minerals were deposited by combining either primary or secondary uranium from the vein systems with phosphate derived by leaching apatite from the wall rocks. Some of these oxidized minerals may be of hypogene and some of supergene origin.

In contrast, the Mount Belknap caldera in the western source area was filled to overflowing with uranium-bearing ash-flow tuffs and lava flows. These rocks were widely altered by postcaldera steaming and hydrothermal activity. Much of the rock uranium was dissolved and incorporated into the hydrologic regime. Some of this mobilized uranium was redeposited in favorable environments within the caldera, but much seems to have been transported elsewhere. Some of the fugitive uranium may have been redeposited across redox fronts in sedimentary fills in adjacent basin-range valleys.

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Uranium in Volcanic and Volcaniclastic Rocks: Discussion of Examples from Canada, Australia, and Italy

Uranium deposits and prospects in volcanic and volcaniclastic rocks encompass a broad spectrum of genetic types, as illustrated by examples from Canada, Australia, and Italy. The hosts are commonly enriched in Zr, Ba, Sr, Rb, REE ± Th, and anomalous amounts of F are usually present. Additional metals such as Mo, Zn, and Cu may be present in economic concentrations in some of the occurrences, but there is no consistent U-base metal association. Associated comagmatic intrusives are locally enriched in Sn, W, Mo, U, and F ± Th. Mineralization is associated with both volcanic and volcaniclastic rocks surrounding subaerial volcanic complexes, and in some places with intercalcated epiclastics. Uranium mineralization is also hosted by euxinic sedimentary-tuffaceous facies adjacent to the volcanic complexes. The volcanics are generally, though not exclusively, acid in composition, have alkaline affinities, and are typical of the variety developed in continental rift systems. The mineralization within the volcanic and volcaniclastic rocks is generally conformable showing a preference for more clastic permeable units. Structurally controlled mineralization may occur and is sometimes of economic importance. In both places the controlling features have acted as channelways for migrating hydrothermal and ground-water solutions. Alkali, CO_2, and H metasomatism commonly accompany the ore-forming process.

The uranium is considered to be of magmatic origin, transported by F- and CO_2-rich hydrothermal fluids which have percolated through the volcanic pile. Under favorable conditions additional uranium may have been scavenged during transport of the ore fluids, during metasomatism or by ground waters circulating on the flanks of the caldera(s). Subaqueous venting of hydrothermal fluids distal to the volcanic centers may give rise to uranium concentrations within reducing (sulfide-rich) sedimentary facies. Precipitation of uranium in the subaerial or subaqueous environ may have been influenced by H_2S exhalation in the vicinity of fumaroles or by dissolved H_2S provided by a plumbing system. For these deposits in which F is a significant component it is probable that U-F complexes transported by acid solutions have been destabilized by changes in pH (and Eh) due to mixing with mildly acid to alkaline ground waters or due to precipitation of the fluoride ion. Precipitation of any free or clay-absorbed uranyl ion would also be promoted by the presence of H_2S.

Although some later supergene processes may have upgraded the primary uranium concentrations, I interpret the mineralizing episode(s) to be synvolcanic. This does not deny the importance of the intermixing of ground waters and the uranium-rich hydrothermal fluids as a means of inducing uranium precipitation, or the scavenging of uranium by these fluids as they percolate through the volcanic pile.

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Peralkaline Ash-Flow Tuffs in Santa Clara Canyon, North of Chihuahua City, Mexico, Possible Source Rocks for Uranium

A thick sequence of upper Oligocene peralkaline ash-flow tuffs and an associated vent complex are located in Santa Clara Canyon, 91 km north of Chihuahua City, Mexico. The principal unit, the Cryptic Tuff, is a comendite and contains about 1% phenocrysts that include sanidine (Or $_{45\text{-}55}$) quartz, hedenbergite, and magnetite. A complete cooling unit consists of: (1) a basal vitrophyre with associated spherulitic pods; (2) greenish, densely welded tuff that contains stretched pumice lapilli; (3) a banded red and light pink zone that contains flowage features and shear folds; (4) a highly porous zone with abundant quartz and sanidine in cavities; and (5) a thick zone of micropoikilitic sanidine and quartz interspersed with riebeckite and aegirine. Flow breccias that contain fragments of the different Cryptic tuff varieties usually separate micropoikilitic riebeckite tuff units. A north-south-trending vent zone (at least 3 km long) is present in lower Santa Clara Canyon where over 400 m of Cryptic tuff is exposed. Flow foliation is vertical in the vent area. Overlying the Cryptic sequence is the bluish, comenditic Campana tuff. It is densely welded and contains about 10% sanidine and quartz phenocrysts set in a groundmass that includes riebeckite and matted aegirine needles.

A minimum loss of 8 mg U_3O_8 per gram of Cryptic tuff has been calculated using data for glassy and massive riebeckitic phases. These paralkaline tuffs could have been source rocks from which large amounts of uranium were mobilized.

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Icelandite and Aenigmatite-Bearing Pantellerite from McDermitt Caldera Complex, Nevada-Oregon, and Their Petrogenetic Significance

Icelandite, apparently the first to be recognized in the western United States, is a petrographically important component of the volcanic suite of the middle Miocene McDermitt caldera complex. Median major-element composition of seven rocks that both pre-date and post-date the major ash-flow sheets exposed on the northern margin of the Long Ridge caldera have been determined. Very high Fe contents (9.1 to 10.2 wt % FeO) are associated with low to very low MgO (0.4 to 2.0 wt %); FeO/Mg ratios of from 5.4 to 25 are strongly "tholeiitic." Both alumina and total alkali contents are relatively low. With the exception of their significantly higher K_2O contents (3.1 to 4.7 wt %), the rocks are chemically similar to icelandites from hot-spot-related oceanic islands such as Iceland and the Galapagos that are situated near spreading centers. A very thin unit of crystal-rich pentellerite welded tuff containing 1.5 vol % aenigmatite phenocrysts underlies the lower major ash-flow sheet exposed at the northern margin of the Long Ridge caldera. Analyses of progressively Fe-rich intermediate and silicic rocks given by Greene provide evidence for a coherent and continuous rock series from icelandite to peralkaline rhyolite. The high FeO/MgO ratios of the icelandites and the presence of aenigmatite in the tuff support a petrogenetic model for the intermediate and silicic rocks of the McDermitt complex involving extensive high-level differentiation of mantle (diapir?)-derived subalkaline mafic magma under conditions of low f_{O_2} and f_{H_2O}. The K_2O and U (4 to 5 ppm) contents of the icelandites suggest that the parent magmas were moderately rich in these and other lithophile elements.

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Geochemistry of Hydrocarbon Source Rocks, Palo Duro Basin, Texas

The sparsely drilled Palo Duro basin of the Texas Panhandle remains an exploration frontier. An understanding of source rock geochemistry can aid in evaluation of its hydrocarbon potential. To determine whether sediments in the basin contained sufficient organic matter to generate hydrocarbons, samples collected from 20 geographically widespread wells were analyzed for total organic carbon content (TOC). Highest values of TOC, up to 6.9%, occur in Upper Permian San Andres dolomite in the southern part of the basin. Pennsylvanian and Wolfcampian basinal shales contain up to 2.4% of TOC and are fair to very good source rocks.

Source beds in the Palo Duro basin had to reach sufficiently high temperatures to generate hydrocarbons from disseminated organic matter. Kerogen color and vitrinite reflectance, which indicate maximum paleotemperatures, were studied in all samples containing greater than 0.5% TOC.