within or adjacent to small fluorine-rich rhyolitic dome complexes or tuff sheets. Examples studied include Spor Mountain, Utah (Be-U-Li-F), the Honeycomb Hills, Utah (Be-U-Li-F), Wah Wah Mountains, Utah (U-F), and the Black Range, New Mexico (Sn-Be-F). The formation of these and similar deposits begins with the emplacement of a rhyolitic magma, fractionated in lithophile metals and complexing fluorine, that rises to a shallow crustal level, where its roof zone may become further enriched in volatiles and the ore elements. During initial explosive volcanic activity, aprons of lithic-rich tuffs and surge deposits are erupted around the vents. These early pyroclastic deposits commonly host the mineralization, owing to their initial enrichment in the lithophile elements, their permeability, and the reactivity of their foreign lithic inclusions (particularly carbonates). The breccias are capped by thick topaz rhyolite lavas or welded tuffs that can serve as a source of heat and of additional quantities of ore elements. Devitrification, vapor-phase crystallization, fumarolic alteration, or the formation of lithophysae may free the ore elements from the glass matrix and place them in a form that is readily leached by percolating meteoric waters. Heat from the rhyolitic sheets drives such waters through the system, generally into and up the conduit and out through the early tuffs. Secondary alteration zones (K-feldspar, sericite, silica, clays, fluorite, carbonate, and zeolites) and economic mineral concentrations may form in response to this low temperature (less than 200°C) circulation. After cooling, meteoric water continues to migrate through the system, modifying the distribution and concentration of the ore elements (especially uranium). In this model, the ore elements are derived essentially from the volcanic vent complex itself, although contributions from the underlying magma chamber are not excluded. Plutons and country rocks beneath such vent complexes may themselves contain disseminated, vein, or replacement deposits of U, Th, Be, Sn, Mo, W, Nb, Ta, or associated elements.

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Geology of Rancho el Papalote Area, Chihuahua, Mexico

The Rancho el Papalote area is 35 km north of Chihuahua City and includes Minas Terrazes. The oldest rocks are highly fractured (17% dilation), massive Cretaceous biomicrites, containing rudistid bioherms, that crop out on ridges and peaks surrounded by volcanic rocks of two eruptive periods. The older volcanics are altered rhyolite and/or dacite flows, flow breccias, and minor lithic tuffs. The flow breccias are thickest around Cerro Choloma which may represent a vent. A boulder breccia containing limestone and chert clasts is along the limestone-older volcanic contact. The younger volcanics are rhyolite ash flows with minor basalt and andesite flows. There are at least five cooling units. A 44-m.y. (initial $^{87}Sr/^{86}Sr$ ratio = 0.7048) old vitric-crystal tuff (22% phenocrysts, sanidine/quartz = 4.5) overlies the older volcanics 1 km west of the ranch buildings. The "Red Platy," an ash-flow rhyolite, overlies the 44-m.y. tuff and is a distinctive marker bed. A small dike cutting the tuff may represent a vent for the Red Platy. The remaining units, vitric tuffs in the eastern part of the area, dip gently east and are cut by northwest-trending normal faults. The first of these ash flows has a basal lithic zone and contains 3% sanidine phenocrysts (Or 45). The next unit is vesicular at its base and has 6% sanidine phenocrysts. The youngest ash flow contains sanidine, quartz, and fayalite phenocrysts (sanidine/quartz = 1, phenocrysts = 4%). A basalt above the Red Platy contains distinctive gabbroic xenoliths. On the south the older volcanics are overlain by an andesite flow. At Minas Terrazas, copper deposits occur in skarns near a felsic intrusive. These skarns are mainly andradite and contain small amounts of pyrite and chalcopyrite.

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Gamma Ray Spectrographic Study of Stream Sediment Samples, Pena Blanca, Chihuahua

A stream sediment survey was conducted in the Pena Blanca uranium district, Chihuahua, Mexico, to determine the applicability of gamma ray spectrometry as an exploration method for volcanogenetic uranium deposits. The Pena Blanca district is 40 km northeast of Chihuahua City, in outflow facies of ash flow tuffs, which are 45 to 35 m.y. old. The minerlization in the district is confined to these ash flows and the underlying Cretaceous limestones.

Stream sediment samples were collected and 500-g, 100-mesh separates were analyzed for eU, eTh, and eK. The samples were also analyzed for both acid extractable uranium and total uranium.

The results of the study show that, with the use of two standard deviations from the mean as an anomalous value, the gramma ray data show anomalies, not over the deposits, but at the break in slope in the streams and at the proximal edge of alluvial fans. Other anomalies were detected by this method, but they were single-sample anomalies. The extractable uranium and the total uranium data show a high degree of correlation (0.92), and also correlate well with the eU values determined for the stream sediments. Uranium being mobilized from the Pena Blanca deposits produced geochemical anomalies at the tops of alluvial fans. This knowledge can be applied to exploration programs elsewhere.

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Geology of Lakeview Uranium District, Oregon

About 400,000 lb (181.4 Mg) of U_3O_8 have been mined from Tertiary volcanic rocks near Lakeview, Oregon, mostly from uraninite-coffinite ore bodies at the White King mine. At this deposit, tuffs and tuffaceous sedimentary rocks are overlain by a basaltic lahar which is capped by basalt flows. The tuffaceous rocks are intruded by flow-banded rhyolite. Most of the ore is in the rholite and adjacent tuffaceous rocks, but uraniferous shear zones cut the lahar, and the basalt is highly altered. Most of the uraniferous rock is silicified and brecciated, and has high As, Hg, Mo, and Pb together with secondary U minerals.

Within 10 km of the mine are nine smaller uranium occurrences, four of which are in, or adjacent to, flow-banded rhyolite domes which are considered endogenous. However, five occurrences are distant from surface exposures of rhyolite: three in volcanic sandstone and tuff near contacts with basalt, and two in a thick sequence of rhyolitic to dacitic ash flows.

At the White King mine and most of the other occurrences, uranium was probably deposited from epithermal fluids released during rhyolite intrusion. These fluids could have migrated some distance from the intrusions along fractures or through permeable sedimentary rocks. Capping basalts, which are cut by the intrusions, appear to have arrested the movement of uranium at several occurrences.