VULCANOSPELEOLOGY OF THE LOWER SNAKE RIVER BASIN, IDAHO

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The Snake River plain is a broad, arc-shaped downwarp trending across Idaho from west to east. This basin has been filled with plateau basalts interbedded with loess and river sediments. The plain can be divided into a lower, older section, and the easterly younger or upper section. This paper will look at origins of the Snake River Plain and how vulcanospeleologic landforms have played a part in formation of today's structures.

SNAKE RIVER PLAINS: REGIONAL SETTING

Volcanism has greatly influenced development of the western North American continent. This volcanism is due to the collision and subsequent interaction of the North American Plate with the Pacific Plate. Volcanism, periodic oceanic submergence, continuing metamorphism and orogeny have produced the complex history of western North America. Action continues today, as witnessed by the recent eruption of Mount St. Helens, continuing seismic activity throughout the Northwest, and the relatively recent eruptive sequences of Craters of the Moon National Monument.

GEOMORPHIC DEVELOPMENT

Historically, geology texts have oversimplified by classifying the Snake River Plain in the same geomorphic class as the Columbia River Basalts and other plateau basalts like the Deccan Basalts of India. Others have attempted to class volcanoes as Hawaiian or effusive and Strombolian or explosive, again an over-simplification. Recent studies by Ronald Greeley and others have shown that the Snake River Plain is indeed a separate morphological class of volcanism. Greeley terms the volcanism of the Snake River Plain as Basaltic Plains volcanism and places it intermediate between basaltic flood eruptions and Hawaiian, sharing characteristics of both.

Idaho has had its share of the complex development of western North America, ranging from the Precambrian Belt Series of metasediments and Jurassic batholithic intrusions to the recent Columbia River Basalts and Snake River Basalts. The Snake River Plain crosses southern Idaho from the Island Park Caldera in the east, 500 km westward to the Oregon border, in the shape of a gentle arc. It ranges from 500 km wide in the east to 80 km wide in the western portion. The youngest rocks are found in the central and eastern portions of the plain. The lavas are principally olivine tholeiites with low SiO_2 and alkalis with high Fe content.

SUBPROVINCES AND SPELEOLOGY

The Snake River Plain is divided into two separate subprovinces, approximately at the Great Rift area: the Eastern Snake River Plain and the Western Snake River Plain. Gravity anomalies, well core data, and other field research suggest that the Eastern Snake River Plain is a broad downwarp, while the Western Snake River Plain is a graben filled with interbedded sediments and basalt flows to depths of at least 1,000 m.

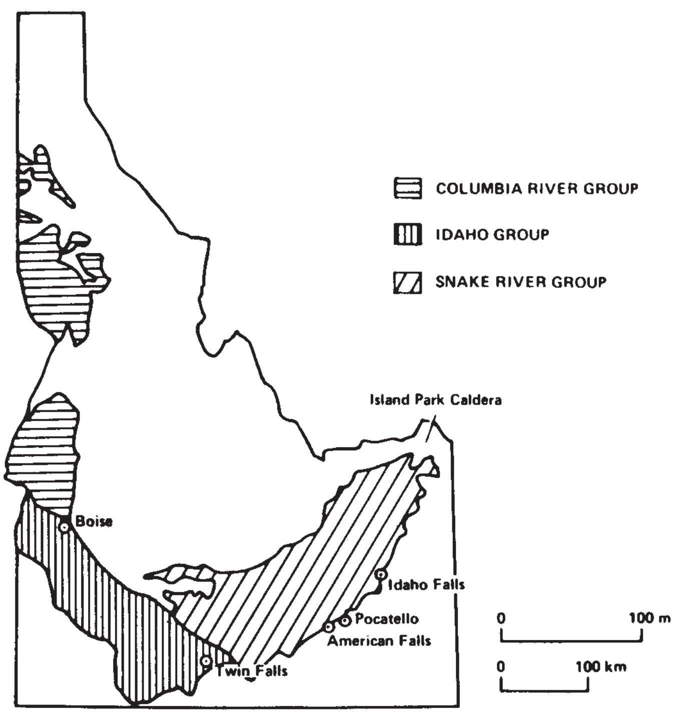

Figure 1. Distribution of Snake River groups and other Cenozoic lavas in Idaho (from Greeley).

Subsidence in the Western Snake River Plain has taken place along a series of northwest-trending faults. The northern edge of the plain is a sharp escarpment which is estimated by Malde to have an aggregate throw of at least 3 km. Malde suggests that the Western Snake River Plain may be structurally controlled by a major break in the earth's crust. Extensive fissure flows fill the western graben while vents or short fissures produce a series of complex overlapping flows filling troughs and valleys of the undulating subsurface floor of the Eastern Snake River downwarp.

In both, features are typical of lava flows, such as: pahoehoe, flow margins, pressure ridges, columnar basalts, pillow basalts, subsidence troughs, calderas or craters, and (of course) lava tubes. These features are similar to those found in Hawaiian and Columbia River Basalts, but differences exist. Columbia River Basalts have vaguely defined fissure-controlled vents and a low profile, while Hawaiian-type vents are well-defined with a higher profile. Greeley notes these differences and distinguishes the Snake River Plain vents, calling them low shields. This difference is easily observed in viewing the vents from a distance. The low slopes and spreading flows have produced lava tubes of short length, usually found near the vent where slope is sufficient to allow tube drainage and thus final formation of a cave. In a few cases, such as Bear Trap Cave, Bear Den Butte, and Black Ridge Crater, a flow of large size was emplaced. In these larger flows, trenches formed, but apparently the slope did not allow extensive drainage, producing only sporadic, minimal-length lava tube caves.

In a few cases, such as the Tee-Maze System and Gypsum Cave, flow was confined by low local topography and slope was sufficient to produce open tubes of substantial length. Pot O'Gold Cave in the

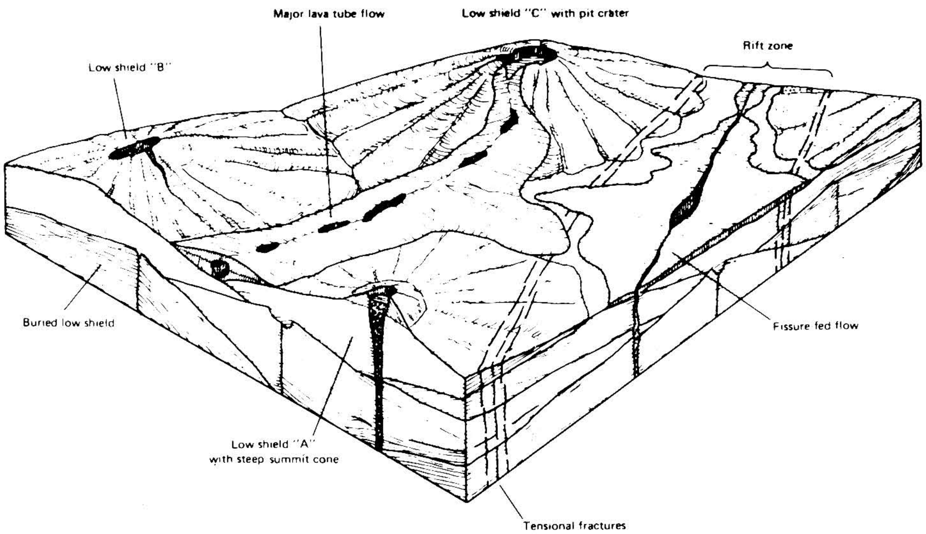

Figure 2. *Block diagram (from Greeley) showing the relationship of low shields, major lava tube flows and fissure flows.*

Figure 3. *Typical lava tube opening in the study area (Boneyard Cave).*

Figure 5. *An unusual lava blister cave in the Shoshone area (Abo Dome).*

Figure 4. *Gypsum Cave is 2 km long. Here, the flowing lava was confined by topography, producing lava tube caves of unusual length.*

Figure 6. *Bifurcation in T-Maze Cave.*

Figure 8. Parts of Pot O'Gold Cave are unusually spacious.

Figure 9. Ledge detail in Pot O'Gold Cave.

Tee-Maze System has a length of 2.5 km, while Gypsum Cave is 2 km long, but these are exceptional for the area.

CONCLUSIONS

Volcanic vents and lava flow played a large part in the development of the Snake River Plain. Unfortunately, environments suitable for formation of extensive lava tubes were rarely present, resulting in the prevalence of short-length tubes found today. The lavas probably formed additional tubes which were not drained due to the low slope gradient.

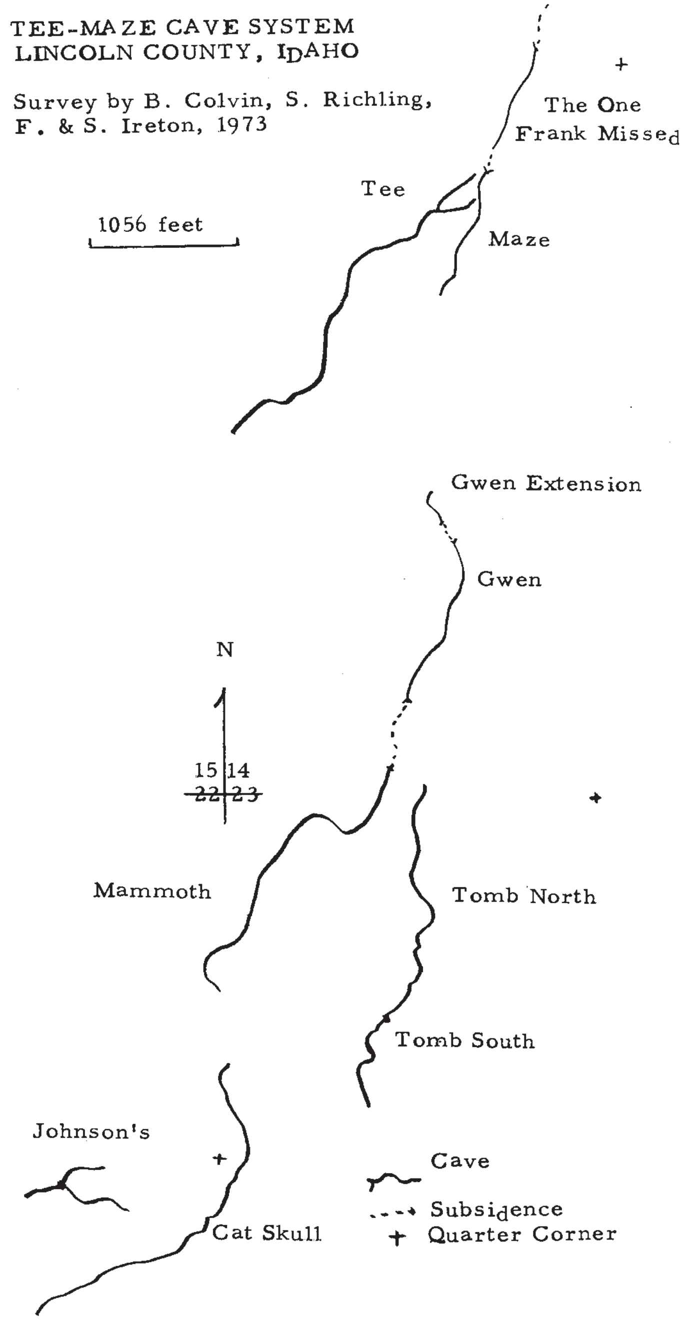

Figure 7. Tee-Maze Cave System, Lincoln County, Idaho.

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