THE TERTIARY GEOLOGY AND IGNIMBRITE PETROLOGY OF THE GRANT RANGE, EAST CENTRAL NEVADA

by

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ABSTRACT

Tertiary rocks in the Grant Range in the eastern Great Basin, Nevada consist of 5,000 to 15,000 feet of rhyolitic ignimbrite sheets, non-marine sediments, and siliceous flows. From oldest to youngest the major units are the 1) Sheep Pass Formation, lacustrine limestone, Middle to Upper Eocene; 2) Railroad Valley Rhyolite, 36 m.y.; 3) Calloway Well Formation, ignimbrites; 4) Stone Cabin Formation, ignimbrites; 5) Windous Butte Formation, ignimbrites, 33 m.y.; 6) Currant Tuff, tuffaceous sediment; 7) Needles Range Formation, ignimbrites; 9) Horse Camp Formation, tuffaceous fluvial and lacustrine sediments, Mio-Pliocene; 10) local andesite and dacite flows, Upper Pliocene-Pleistocene; 11) Quaternary terraces, lake sediments, and alluvial deposits.

Mesozoic thrusting associated with the Sevier Orogeny in the Grant Range was confined to decollement-like shear zones characterized by omission instead of repetition of strata. Tertiary units were deposited nearly parallel to the underlying Upper Paleozoic strata. Volcanic activity began about 5 m.y. after initial Tertiary normal faulting. The first two ignimbrite formations inundated topographic irregularities; the upper units covered large regions with thin continuous sheets. Three small ignimbrite vents are present, but no caldera or major dike systems were located. Large scale, north-south trending, normal faulting (Miocene to Recent) has created sedimentary basins, triggered large scale gravity sliding, and formed the range boundaries. East-west strike-slip faulting has offset the ranges. Progressive tilting from the Pliocene to Recent has caused strata above an incompetent Carboniferous shale to slide variable distances to the east.

Deuteric alteration and, to a lesser degree, weathering controlled the vertical chemical variation in ignimbrite cooling units. A potassium-sodium exchange was the most distinctive deuteric alteration phenomenon. The magnesium and iron distributions were also greatly controlled by deuteric alteration. Weathering affected the chemistry primarily by leaching sodium. Hydrothermal alteration added potassium and removed sodium in plagioclases and volcanic glass.

Compositions of bulk ignimbrite samples indicate that anatectic formation of ignimbritic magmas occurred at undersaturated vapor pressures in excess of 500 to 2000 bars, and stratigraphic relationships imply that anatexis occurred at depths on the order of 11 to 15 kilometers. Compositions of ignimbrite glasses and coexisting crystals show that eutectic crystallization of this ignimbrite magma occurred under vapor pressures on the order of 3000 to 5000 bars, which correspond to an overburden pressure of 11 to 17.5 kilometers.

The variety of tectonic environments of ignimbrite regions throughout the world show only one common feature, tensional or extensional faulting. The coincidence of extensional stresses and a granitic magma under high water pressure is probably necessary for the formation of ignimbrites.