A GEOCHEMICAL STUDY OF RHYOLITIC MELT INCLUSIONS IN IGNEOUS PHENOCRYSTS FROM LOWER DEVONIAN BENTONITES

by

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ABSTRACT

Pristine, rhyolitic melt inclusions occur in chemically resistant phenocrysts in Paleozoic bentonites that are preserved in the Lower Devonian Helderberg Group limestones of New York State and the Central Appalachian Basin, and in the Esopus Formation in New York State. These melt inclusions have been chemically analyzed in order to (1) obtain constraints on their magmatic sources and (2) to chemically "fingerprint" the host bentonites so that they can be used as time horizons for stratigraphic correlation.

High-precision electron microprobe and instrumental neutron activation techniques have been developed in order to obtain major-, minor-, and trace-element abundances. Using these techniques, the abundances of these elements have been obtained with adequate precision not only to distinguish one bentonite from another, but to confidently distinguish differences between the composition of different melt inclusions from a single bentonite.

Pre-entrapment or post-entrapment processes may alter the chemistry of melt inclusions so that they are not reliable samples of the original melt. Boundary layer enrichment of slowly-diffusing incompatible elements in the liquid during crystal growth has been modeled numerically in order to assess the effect of this process on melt inclusion chemistry. The morphology of host-quartz crystals and the textures of melt inclusions within the host phenocrysts have been described in an effort to constrain inclusion entrapment processes. Post-entrapment crystallization has been identified in some bentonites, and an experimental technique has been developed to rehomogenize crystallized melt inclusions so that they can be analyzed by electron microprobe.

Four groups of Lower Devonian bentonites have been distinguished based on the similarity in the minor- and trace-element content of the melt inclusions. The bentonites

within these groups apparently share a common source that may be similar to more recent continental ash flow tuffs such as the Bishop or Bandelier Tuffs.

Geochemical fingerprinting of inclusions has been successful in establishing important stratigraphic correlations between bentonites. The boundary between different bentonite groups can be recognized across wide geographic regions and has been used as a basin-wide correlative feature. These correlations are compared to the stratigraphic framework previously established by stratigraphers.

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