GEOCHEMICAL FINGERPRINTING OF VOLCANIC AIRFALL DEPOSITS: A TOOL IN STRATIGRAPHIC CORRELATION

by

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ABSTRACT

Chemical fingerprints of volcanic airfall deposits obtained from high-precision electron microprobe analysis of glass and phenocrysts phases provide geochemical correlations with temporal precision unattainable by other methods. In this research electron microprobe analysis (EMA) techniques, to fingerprint chemically and correlate fresh and altered volcanic airfall deposits, have been utilized to test the value of this tool for future research on stratigraphic correlation. The following samples were chosen from within a variety of sedimentary rocks widely separated spatially and temporally:

- ~450 Ma old upper Middle Ordovician K-bentonites (altered volcanic airfall deposits) collected from eastern United States.
- Relatively fresh Pleistocene tuff from ~74 ka old Youngest Toba Tuff (YTT) eruption in Sumatra (Indonesia).
- Fresh Pleistocene volcanic ash from India, and Sulu Sea ODP cores.

This research confirms 14 K-bentonite correlations, of which 10 are reported for the first time, based on chemical compositions of apatite phenocrysts and melt inclusions in quartz phenocrysts. Significant K-bentonite research findings include:

1. Chemical correlation of Hounsfield K-bentonite and the Millbrig K-bentonite.
2. Several new chemical correlations of K-bentonite beds from within the Ordovician rocks in Taconic foreland basin.
3. Melt inclusion chemistry might be the more effective tool for differentiating closely spaced K-bentonites than that of apatite.

Biotite phenocrysts, melt inclusions in quartz and plagioclase phenocrysts, and glass shard chemistry of proximal and distal YTT ash successfully discriminate it with

other closely spaced ash layers. This research reports for the first time, the presence of melt inclusion bearing plagioclase from Pleistocene volcanic ash from India and correlates it chemically to the YTT. The Pleistocene ash from Sulu Sea ODP was not produced by YTT eruption.

The best discriminating elements observed are:

1. Toba biotites - Mn, Ti, Cl, Mg and Fe.
2. Ordovician apatites - Mn, Mg, Fe, Cl, and F (new finding).
3. Melt inclusions and glass shards - Ca, Fe, Mg, Mn, Cl, Ti, K and Na.

Using a dual approach, i.e., glass as well as phenocryst chemical signatures, makes a better tool for differentiating or correlating vertically closely spaced or geographically widely spaced volcanic airfall deposits.

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