Petrogenesis and tectonic evolution of the meso-Proterozic felsic volcanic suite of the Sakoli Group in the Bhandara Craton, Central India

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The Sakoli supracrustal rocks encompassing an area of about 3600 sq km known as 'Bhandara Triangle' of Central India are surrounded by the Amgaon granitic gneisses forming the basement for Sakoli Group with highly tectonised contact. Chemically the felsic volcanics of Sakoli Group lie in rhyolite-rhyodacite field and the relationship of Zr/TiO_2 *vs* Nb/Y shows that felsic pyroclastics are relatively less evolved members of the felsic suite that fall in the rhyodacite-dacite-trachyte field. Other members of the felsic suite shows a spread in comendite-pantellerite-trachyte field. The pyroclastics are the least alkaline, hence least evolved members of the felsic suite, while the lavas emplaced at conduit are most evolved.

The geodynamic setting of the felsic lavas is interpreted by using various discrimination diagrams and ratios of incompatible elements. The La/Yb *vs* Sc/Ni discriminant function shows that the felsic suite was evolved in 'continental margin arc' to 'evolved oceanic arc' like mixed setting. The La/Yb *vs* Yb discrimination indicates extensional set up for the pyroclastics and the La/Yb *vs* Th/Yb functions suggest that the lavas were evolved in immature transitional to marginal arc setting with evolutionary trends towards Andean (continental) arc. Overall the ratios of incompatible trace elements for the felsic volcanics indicate a continental marginal arc to marginal extensional basin set up, suggestive of a back arc rifting at the continental margin. Pyroclastics in general have highest LREE enrichment as well as high HREE content of the felsic suite. Hydrothermally altered Pyroclastics have HREE levels compatible to felsic suite, but the depleted middle and LREE are similar to the REE pattern of granite dykes from the area. The hydrothermal fluids that caused this alteration may hence be related to granite emplacement. The hydrothermal fluids have been enriched in HREE possibly because these fluids were generated by partial melting of the residuam of the first partial melt that generated felsic magma.

Overall REE pattern and incompatible trace element ratios suggests that the magma for the Sakoli felsic volcanic suite was generated by a mixed process. An initial enriched mantle partial melting event unrelated to the subduction process generated primary melt. Its emplacement at deep continental levels, possibly related with subduction regime that generated a subsequent deep continental crustal partial melt. Mixing up of both the melts resulted in the mixed transitional character of the felsic suite. The resultant mixed melt possibly had short, shallow crustal residence after initial emplacement and fractionation.

Submicrometer organic grains: Widespread constituents of the early Solar System

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Primitive meteorites and interplanetary dust partcles (IDPs) contain remants of interstellar organic matter, marked by anomalous H and N isotopic ratios [1]. These isotopic anomalies are attributed to mass fractionation during chemical reactions at cryogenic temperatures (10 – 100K) in a cold molecular cloud. Significant variations in the chemistry and isotopic compositions of organic compounds within and between these samples suggest varying histories of alteration and dilution of the presolar components.

Recent studies have reported large H and N isotopic anomalies preserved in sub-μm organic inclusions in both meteorites and IDPs [2]. In the Tagish Lake meteorite, the largest H and N isotopic anomalies are associated with sub-μm, hollow organic globules [3]. The common physical, chemical, and isotopic characteristics of these globules suggest that they formed before being incorporated into their parent meteorite. These organic globules probably originated as organic ice coatings that formed on preexisting ice or mineral grains in a cold molecular cloud. Radiation driven photochemistry may have processed them into refractory organic grains. This model implies that submicrometer organic grains were widely distributed throughout the solar nebula during the epoch of planet formation.

Submicrometer organic particles were detected by the Giotto and Vega encounters with comet Halley, termed CHON particles based on their major element chemistry. The first direct samples of cometary dust (comet Wild-2) were returned by the Stardust spacecraft in January 2006. These samples exhibit widely varying, fine grained mineralogy similar to anhydrous IDPs, including submicrometer carbonaceous grains. The submicrometer organic grains from comet Wild-2 exhibit H and N isotopic anomalies of similar magnitude to those commonly observed in primitive meteorites and IDPs [4,5].

Isotopically anomalous, submicrometer organic grains have now been observed in meteorites, IDPs, the Oort-cloud comet Halley, and the Kuiper-belt comet Wild-2, suggesting that such grains were prevalent throughout the protoplanetary disk.

References

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