Magnetite-tuff from the Himalaya, India

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During an expedition beyond the Great Himalayan Range, an acid volcanic suite of rocks was recorded near Mangsu La (31°22′; 78°30′), at an altitude of 5400 m above m.s.l. The rocks exposed form the basal sequence of a newly discovered Tethyan basin and have been grouped into an unfossiliferous Hilap Formation (Fig. 1a) of Precambrian-early Cambrian age. It comprises chlorite-phyllite and fine-grained quartzite. The Hilap Formation is overlain by calc-phyllite containing Ordovician corals (Fig. 1b). The basal part of the Hilap Formation is intruded by a biotite granite which contains xenoliths of basic and ultrabasic rocks.

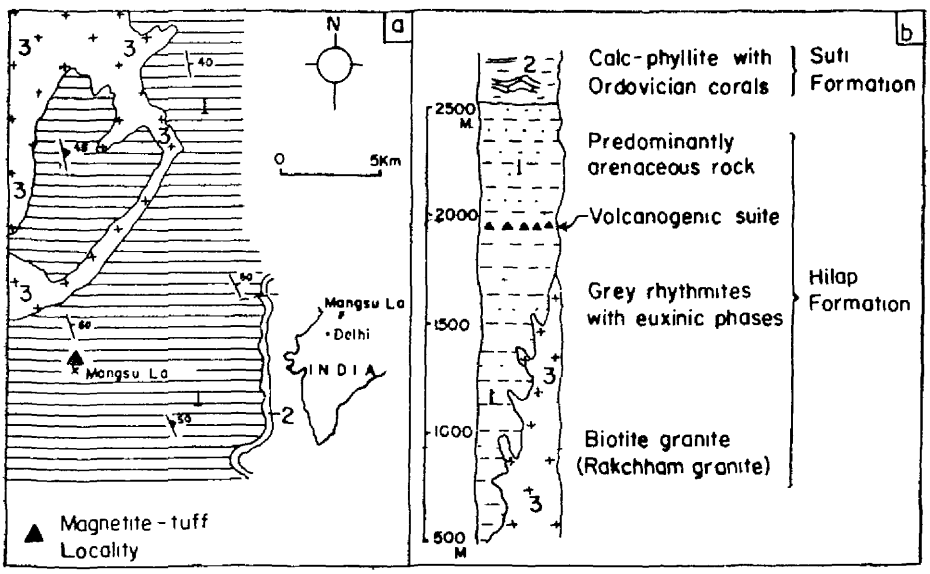

Figure 1. a) Sketch map of Mangsu La area with geographic location.
b) Lithocolumn of the exposed sequence at Mangsu La.

The volcanogenic suite of rocks includes rhyolite-tuff, volcanoclastic-ash, quartz-crystal tuff, carbonaceous cherts and saccharoidal carbonate rocks beside magnetite-tuff. The white coloured rhyolite-tuff is made up of partially altered sodic plagioclase with lamellar twinning, interlocking fine-grained quartzose material, muscovite, zircon with leucoxene, siderite rhombs, 'primary' pyrite cubes and fragments of devitrified glass. Volcanoclastic-ash is represented by cryptocrystalline to opaline silica interspersed with ash and magnetite dust. It encloses fragments of partially devitrified glass with palagonite rim and siliceous core. Some of these fragments have ferruginous rims. Flaser bedding indicates deposition close to sediment water interface.

0016 - 7622/84/25-1-67/$ 1-00

The magnetite-tuff consists of mainly opaline to very fine quartz and ash, embedding octahedral magnetite grains (Fig. 2) and partially devitrified glass fragments

Figure 2. Magnetite crystals in tuffaceous material; Enveloping glass partially divitrified.

with ferruginous rim and siliceous core. The euhedral magnetites with sharp crystal edges do not show any abrasion and are evidently ash-fall material. Partial divitrification of glass enveloping the magnetite grains has given rise to fibrous silica along crystal boundaries. Magnetite contains inclusions of ash. The trace element content (in ppm) of magnetite is: Cu – 30, Ni – 20, Co – 10, Ba – 10, Ga – 10, V – 300, Cr – 60, Ti – 160, Zr – 30, Mn – 50. X-ray study shows that the magnetite contains minor quartz and no maghemite (Hansgeorg Forester, Pers. Comm.). The formation of maghemite is favoured during the rapid oxidation of magnetite between temperatures 200°C and 400°C (Lepp, 1957). Studies on synthetic magnetite reveal that maghemite is formed only if the former contains appreciable amount of water (David and Welch, 1956). The absence of maghemite in our sample may thus indicate either the absence of water or lack of rapid oxidation at low temperature during its formation.

V, Cr and Ti content of Mangsu La magnetite compares well with those of El laco ore (Frutos and Oyarzum, 1975, Table I, p. 990). Park (1961) regarded the El laco ores to be of igneous origin but Frutos and Oyarzua (1975) contend that these are derived from the remobilisation of older ferruginous schist. However, such source rocks are not known in this part of the Himalaya. We, therefore, consider the magnetite to be of igneous origin. Magnetite-tuffs in identical set-up are also known from Central Iran (Forster and Knittel, 1979) and Southern India (Rajrajan and Sood, 1976).

We are thankful to Hansgeorg Forster of Aachen, West Germany and our colleagues M. L. Parimoo, R. N. Srivastava and A. D. Ahluwalia for various help.

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(Received May 26, 1982 Revised form accepted Jan 28 1983)