40Ar/39Ar geochronology of the Sylhet Traps, eastern India and their relationship to the Kerguelen plume related magmatism

J.S. Ray (jsray@prlernet.in), K. Pande (kanchanpande@iitb.ac.in)
Planetary & Geosciences Division, Physical Research Laboratory, Ahmedabad 380 009, India

Introduction

The Rajmahal-Bengal Traps of eastern India form part of a Large Igneous Province (LIP) that includes rifted margin basalt in southwest Australia (Bunbury, Naturaliste Plateau), and lavas forming the central and southern Kerguelen Plateau (e.g., Davies et al., 1989; Kent et al., 2002) (Fig. 1). This LIP is generally believed to be related to Kerguelen hotspot activity that began during the early Cretaceous (e.g., Frey et al., 2000; Kent et al., 2002). The oldest volcanism attributed to the Kerguelen plume are the 132 and 123 Ma old Bunbury Basalts (e.g., Coffin et al., 2002) and the ~118 Ma old Rajmahal-Bengal Traps (Kent et al., 2002). Although the extent of the latter in space and time is unknown, it has been postulated that the magmatic activity in the eastern India was contemporaneous with the oldest activity on the southern Kerguelen Plateau (Kent et al., 2002). The lesser-known Sylhet Traps of eastern Indian state of Meghalaya, exposed ~400 km east of the Rajmahal Traps (25°59′N, 91°8′E; Fig. 1), are also considered to be part of the above LIP (e.g., Baksi, 1995) despite limited geochronological evidence. In an attempt to test the hypothesis of their contemporaneity we dated the Sylhet Traps by 40Ar/39Ar incremental heating technique.

Samples and Method

Samples were collected from a well exposed section along the Cherrapunjii-Shella Bazar highway. Two fresh samples, with little alteration, of fine to medium grained massive tholeiitic basalt from flow 4 (ST94-1) and flow 19 (ST94-2) of the section (Fig. 1c) were selected for 40Ar-39Ar analysis by the conventional step-heating method (Pande et al., 2001). About 500mg each of ultrasonically cleaned whole rock sample powder was irradiated along with argon value also distinguishable from the atmospheric argon with MSWD > 0.25. The samples do not show any indication of 39Ar recoil redistribution within the rocks. For both the samples the plateau, isochron and inverse isochron ages were determined using ISOPLOT3 (Ludwig, 2003) through the selected step gas composition using the 40Ar/36Ar correlation diagram (inverse isochron) for the plateau steps showing 2σ error envelopes and the best-fit regression line.

Results

Both the samples yield good plateaus and inverse isochrons (Fig. 2 and 3). The sample ST94-1 yields a 13-step plateau age of 115.9 ± 4.1 Ma with 100% of 39Ar released (Fig. 2a). Its inverse isochron age is 118.6 ± 4.5 Ma with initial argon value indistinguishable from atmospheric argon and MSWD of 0.36 (Fig. 2b). The second sample ST94-2 yields a 9-step plateau age of 115.5 ± 5.4 with 100% of 39Ar released. Its inverse isochron age is 119.0 ± 10 Ma with initial argon value also indistinguishable from the atmospheric argon with MSWD value of 0.25. The samples do not show any indication of 39Ar recoil redistribution within the rocks. For both the samples the plateau, isochron and inverse isochron ages agree within the limits of analytical uncertainty at 2σ.

Summary and Conclusions

The age of eruption of the Sylhet Traps of eastern India has now been determined to be 115.8 Ma.

This age falls within the range of ages (118-115 Ma) reported for various groups of volcanic rocks in the Rajmahal-Bengal province, thereby forms a part of the Kerguelen plume generated large igneous province.

It also suggests that flood basaltic activity in eastern India during early Cretaceous had a large spatial extent, covered an area in excess of ~2×105 km2.

The age of Sylhet Traps and other alkaline activities suggest that the Kerguelen plume related magmatism in this part of India continued well beyond the major tholeiitic pulse at ~118 Ma.

Our results combined with existing geochronological and geochemical information support the proposal that the Kerguelen hotspot was located close to the eastern Indian margin just after 120 Ma (Kent et al., 2002).

References

Duncan, D., 2000, Chemical Geology, v.166, p. 219-249