Occurrence of ash beds in radiolarian cherts from South Andaman Island, Bay of Bengal, India: Evidence for Late Cretaceous explosive volcanism

Explosive volcanic eruptions can produce large amounts of fine-grained pyroclastic material which spreads laterally and the resulting fallout of ash tends to cover the pre-eruptive topography of the depositional surfaces independent of environmental settings[1–3]. Such ash beds are important components of some deep-sea sediments deposited adjacent to areas of explosive volcanism and have been described from rocks of many different ages and localities all over the world[4]. Convergent plate margins/boundaries are considered to be areas of intense volcanism and tectonism[5,6]. The eastern margin of the Indian plate, a part of the Sunda arc, is marked by the Andaman–Nicobar Islands, of which several islands are characterized by the occurrence of ophiolitic suite of rocks of the Cretaceous age[7–11]. Several thin ash beds of microscopic scale are being reported here from the radiolarian cherts of the South Andaman island ophiolites.

The Andaman–Nicobar Islands form a part of the Sunda–Burmese double chain arc system, which is composed of an inner volcanic arc and an outer sedimentary arc, wherein the Andaman–Nicobar Islands form an integral part of the outer sedimentary arc. The main rock types of the Andaman–Nicobar Islands can be broadly divided into (i) ophiolite suite of Cretaceous age, (ii) turbidites (also known as Andaman flysch) of Eocene–Oligocene age and (iii) chalk and limestone of the Archipelago Group of Neogene age[8–11]. Recent studies[12] suggest that the Andaman–Nicobar ophiolites were emplaced at the leading edge of the Eurasian continent during the Mid-Eocene to Late Oligocene subduction event, prior to the currently active Andaman–Nicobar subduction, which was probably initiated during the Late Miocene.

In the Andaman–Nicobar Islands, apart from the explosive volcanic activity of Miocene–Pliocene times[13,14], volcanic activity of two distinct periods has also been reported[13]. The first volcanic episode is of Late Cretaceous[13] related to the ophiolitic suite and the second episode is represented by the Quarternary and recent volcanism at the Barren and Narcondam islands[15]. The Late Cretaceous volcanic rocks are of two distinct types: (i) pillow basalts[11,16] and (ii) K_2O-deficient calc-alkaline rocks referred to as the East Coast volcanics[17]. In the East Coast volcanic association, there are several occurrences of agglomerates and plagiogranites, which are tonalite to trondhjemite in composition with an island arc affinity[18]. Our studies, however, also suggest that even during the formation of the ophiolitic suite of rocks, explosive volcanic activity had taken place.

Radiolarian cherts – an important and the uppermost member of the ophiolitic suite of rocks, occur in all the islands and especially several of its outcrops are seen in South Andaman. The cherts show tectonic contacts at most of the places[8], and are grouped mainly into two types: (i) bedded tuffaceous radiolarian claystones and (ii) bedded radiolarian argillaceous cherts[19]. They are suggested to have been deposited in varied oceanic environments[20]. The studied radiolarian cherts are exposed in the intertidal zone near Bambooflat, north of Port Blair and are in association with conglomerate and grit (Figure 1). The radiolarian chert occurs as dark brown to light green, ribbon-like bands of moderate size, i.e. about 30 m long and 10 m wide (Figure 2). The chert bands vary from 3 to 12 cm in thickness and are composed of claystones which in turn are interbedded with thin shale beds of 1 to 5 cm thickness. Microscopically,

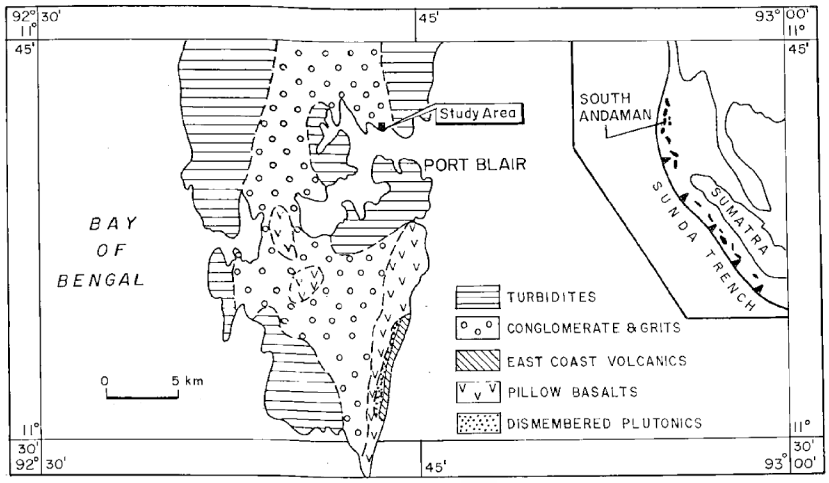

Figure 1. Generalized geological map of south Andaman Island (after Ray *et al.*[17] and Pal *et al.*[14]).

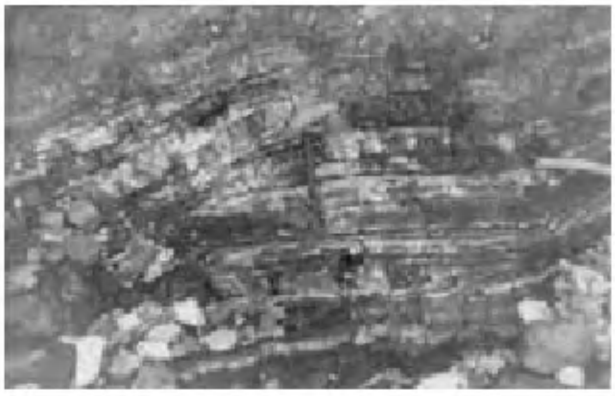

Figure 2. Field photograph of bedded tuffaceous radiolarian cherts. Microscopic study of these cherts shows numerous thin ash beds in a clayey matrix.

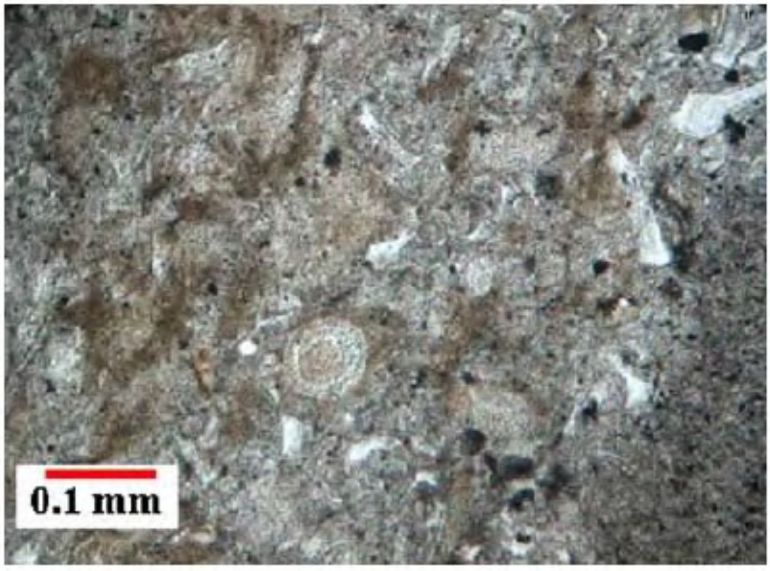

Figure 3. Photomicrograph of tuffaceous radiolarian cherts showing glass shards and radiolarian tests in a clayey matrix.

the cherts are characterized by distinct and numerous compositional layering on a millimetre scale. The individual layers are composed of glass shards, angular fragments of quartz and plagioclase, opaques, basaltic rock fragments along with the radiolarian tests in a clayey matrix alternating with radiolarian tests bearing distinctly fine-grained clay-rich layers (Figure 3).

Occurrence of ash layers in radiolarian cherts in south Andaman Island suggests explosive volcanic activity during the Late Cretaceous, similar to those reported from marine sediments, which provide reliable evidence of explosive volcanism[21]. Further, the different shapes of glass shards, angular fragments of quartz and plagioclase, present in several layers of this chert along with the radiolarian tests provide an unequivocal evidence for intermittent volcanic activity during sedimentation. The source of the ash layers in these cherts, deposited near the continental margin[20], is suggested to be related to explosive volcanic activity related to the East Coast volcanics near the leading edge of the Eurasian plate during an earlier subduction of the Indian plate. This is also substantiated by the inference that the Andaman ophiolites were emplaced at the leading edge of the Eurasian continent during the Mid-Eocene subduction event, prior to the currently active Andaman–Nicobar subduction, which was probably initiated during the Late Miocene[12].

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