Discovery of pyroclastics and dyke in the Mahadek Formation of Meghalaya Plateau

Pyroclastics are fragments produced by the explosive volcanism, that range in size from finer ashes to coarser fragments. Tuff is a marker horizon that helps in dividing the formation[1]. Presence of such pyroclatic components indicates the volcaniclastic status for the sediments and such beds have been found in Cretaceous stratigraphy world over. However, in the Cretaceous stratigraphy of Meghalaya it is recorded from the Mahadek sequence for the first time.

The Cretaceous Mahadek sediments rest unconformably on the Pre-Cambrian granitic complex but at places on the Sylhet traps. Mahadek Formation is divided into Lower and Upper based on sedimentological and chemical parameters[2]. The Lower Mahadek Formation consists of conglomerate and grey coloured fluvial sandstones with pyrite and organic matter. The channel filled, tidal, and wave influenced sediments have been identified by the sedimentary structures within the Lower Mahadek Formation[3]. It is in turn overlain by Upper Mahadek consisting of oxidized purple and brown coloured fossiliferous sandstones. The pyroclastics are located on the Wahblei river section (Long: 91°6'; Lat: 25°18') and the volcanic dyke is located near Mawsynram (Long: 91°35'10"; Lat: 25°17').

Volcanic tuff is fine-grained, grayish-green to greenish in colour. It occurs as 1 m thick beds and lenses at many stratigraphic levels in the Lower Mahadek Formation. However, it is dominant between Lower and Upper Mahadek Formation on the north bank of Wahblei river. It contains 5 to 15 cm sized fine-grained leucocratic, angular rhyolitic fragments composed of fine-grained high quartz, glassy matter and biotite which impart crude flow banding. Above this tuff bed, 15 to 30 cm sized ferrugenous nodules occur as loose boulders. These nodules contain concentric friable shells of haematite, goethite and limonite which appear to be altered mafic matter and standout prominently from the host sediments. Some nodules have rhyolitic core with ferrugenous shells. Their size, shape and association within the tuff suggest that these are projectiles from a nearby vent (Figure 1).

In an exploratory borehole, a 7 m thick volcanic tuff horizon has been intercepted. Its top portion is green in colour, fine-grained and contains high quartz, glassy matter and pyrite granules; it is an acidic tuff (Figure 2). It has sharp contact with the lower part which is dirty white in colour, contains calcite and high quartz; it is criss-crossed by ferrugenous veins and this lower part is identified as calctuff.

Near Mawsynram (6 km from Shillong) on the road cut, the Upper Mahadek purple sandstone is exposed and overlain by Tertiary sandstones with an erosional contact. The near horizontally disposed Upper Mahadek sandstone is cut across by a 5 to 7 m length and 1 m thick rhyolitic dyke with a N40°E–S40°W trend with a dip of 70°SE and abruptly terminates a metre below the Upper Mahadek–Tertiary sandstone contact. It appears to occupy a fault zone along which the dyke has intruded. The dyke is grayish-purple in colour with vitreous quartz and altered glassy matter which often shows crude banding. The age of the dyke (volcanic activity) from the field relations appears to be younger than Upper Mahadek

Figure 1. Mafic volcanic bombs within pyroclastic (tuff) bed. Location, Wahblei river section, Meghalaya.

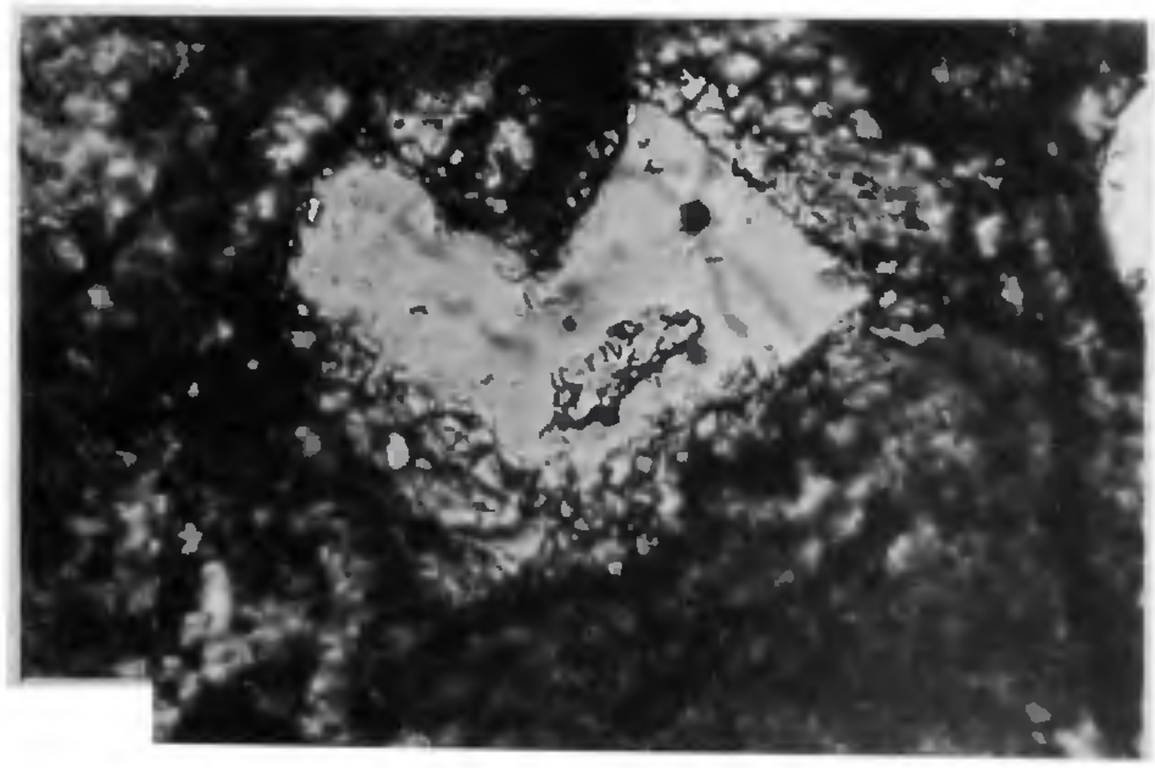

Figure 2. Quartz in the volcanic tuff. Location, Borehole core section, Wahkyn, Meghalaya.

Figure 3. Rhyolite dyke in Upper Mahadek Formation. Location, Near Mawsynram, Meghalaya.

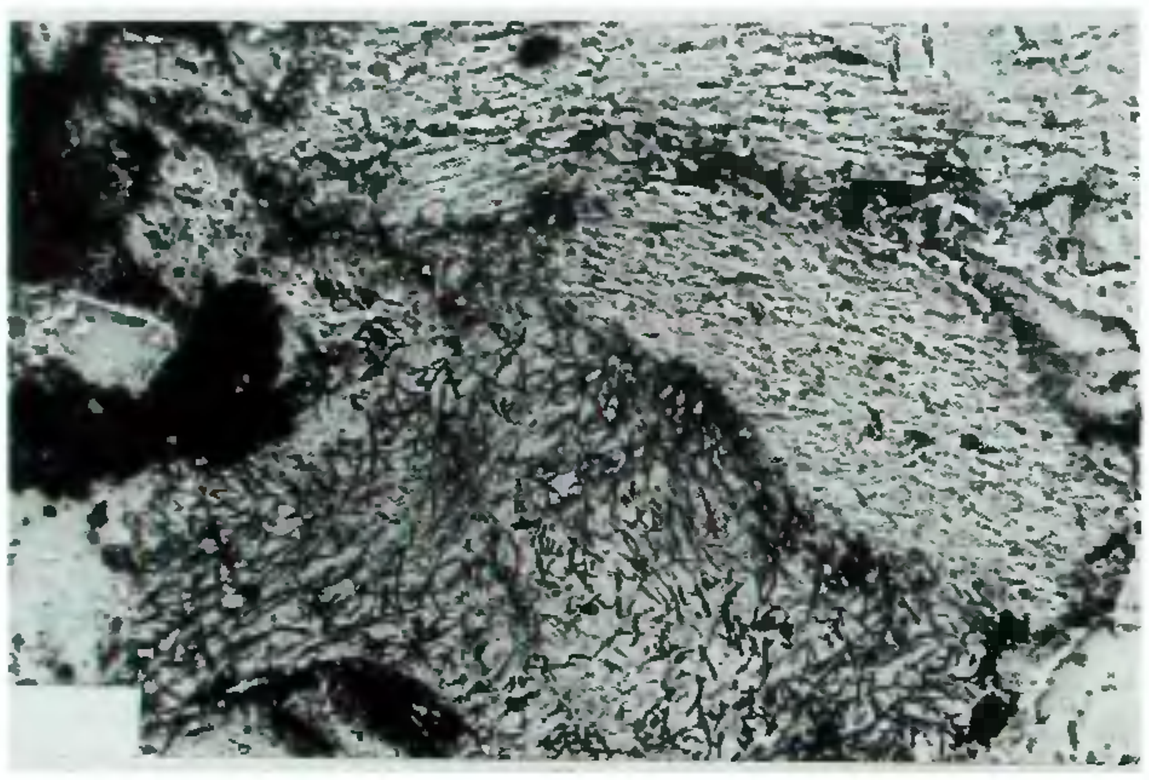

Figure 4. Glassy matter with microlites in volcanic tuff. Location, Wahkyn, Meghalaya.

Formation and older than overlying Tertiary Formation (Figure 3).

During the Cretaceous period the Eastern Gondwana land has witnessed two prominent volcanic episodes; one in the Lower Cretaceous period (Rajmahal–Bengal – Sylhet volcanism, 115–118 m.y.) and the other in the Late Cretaceous period (Deccan volcanism, 60.2–66.5 m.y.)[4]. There were other volcanic provinces during this time in different parts of the world, e.g. Parana Province, Tendeke, Thulean, etc. The Sylhet volcanism could be poly centered, coeval, extended between Sylhet and Rajmahal, like that of Satpura–Narmada–Tapti Province of Deccan Volcanism?[5]. Moreover, in the Cretaceous stratigraphic sequence of the Bangladesh (south of the Meghalaya) volcanic tuff and agglomerates are recorded at many levels[6].

Occurrence of such pyroclastics and dyke extending from Wahblei in the west to Mawsynram in the east of southern Meghalaya, leads us to conclude that the Mahadek sediments comprise significant amounts of pyroclastics possibly derived from the Sylhet volcanism-related vents.

The size, shape and composition of the pyroclastics, their disposition in the Lower Mahadek Formation and that of dyke within the Upper Mahadek Formation provide an unequivocal evidence that when these sediments were deposited a volcanic environment was also present.

The pyroclastics, especially tuff and tuffaceous samples collected from Wahkyn, Domiasiat and other exploration areas contain anomalous quantities of uranium with ranges from 10 to 25 ppm at Wahkyn and up to 1740 ppm at Domiasiat. Mineralogical studies of these samples revealed predominance of glassy matter (Figure 4) along with clasts of high quartz. This glassy matter contains ultrafine inclusions of uranium[7]. The volcanic tuff also contains gases and hot water which mobilize uranium out of the devitrifying tuff and make it available for later low temperature remobilization, i.e. by groundwater[8].

The tuff beds which interleave the sandstone units act as a source and as impervious bounding layers from which the released uranium was remobilized and distributed. This process helped further in uranium mineralization in the Cretaceous sandstone sequence of Meghalaya Plateau.

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