IRIDIUM ENRICHMENT AT CRETACEOUS/ TERTIARY BOUNDARY IN MEGHALAYA

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EXCESS iridium has been observed to occur at the Cretaceous/Tertiary (K/T) boundary at sevei ıl locations on the earth. The source of iridium is believed to be extraterrestrial such as asteroids[1] or comets[2] or the earth's mantle from where it emanated during large scale volcanism that occurred in peninsular India[3]. We report here results of a geochemical study in a marine section in the eastern Tethys across the K/T boundary. The results confirm enhanced iridium levels of 12 ppb at the boundary in Um Sohryngkew river section in Meghalaya, which is correlated with high concentration of several elements such as Fe, Co, Ni, rare earths etc, whereas calcium and barium show depletion at the boundary. The results are compared with geochemical behaviour observed at other sites.

Marine sections preserving K/T boundary are exposed on the eastern margin of the Indian shield, in the Cauvery basin and in Cherrapunji area of the southern Shillong plateau[4]. The Um Sohryngkew river section in Meghalaya is believed to have uninterrupted sedimentation having principal litho units of Cretaceous-Paleocene age which includes the Mahadeo, Langpar, Therria and Lakadong formations. The K/T boundary, based on the studies of planktonic foraminifera lies about 10 meters below the Mahadeo/Langpar contact in light to medium grey shales, characterized by a brown limonitic and nodular shale about 1.5 cm thick and turning more brownish in the Paleocene

The foraminiferal shows an abrupt break in the planktonic constituents across the boundary although quite a few benthic types remain unaffected. The typical assemblages in the cretaceous include Globotruncana-Globigerina eugubina zone[4]

Samples at about 10 cm intervals, across the boundary were collected in 1985, and based on the observation of excess iridium in one sample, a fine sampling at intervals of 0.5–5 cm was done in May 1986, in a 30 cm thick section.

Concentration of iridium, rare earths and several other elements of interest was measured by instrumental neutron activation analysis, followed by radiochemical separation in some cases. Standard procedures were followed[5]. Samples of Allende meteorite and BCR-1 (Columbia River Basalt) were used as standards. Neutron irradiation was carried out at the CIRUS reactor of the BARC, Bombay, to a flux of 10^{18} nvt and counting was done on a 148 cc HPGe detector, located in a 10 cm thick lead shield with the help of Nuclear Data -66 multichannel analyser.. The resolution of the detector was 2.2 keV for ^{60}Co gamma rays. About 20 elements including rare earths, siderophile elements, calcium and barium etc could be thus determined by counting samples for their characteristic gamma rays periodically over several months. Radiochemical separation of iridium involved fusion of the sample in sodium peroxide and selective absorption on ion exchange column[5].

The profiles of some of the elements of interest in Sohryngkew river section are shown in figure 1. In the case of iridium it can be seen that in the boundary layer B-6b, there is an abrupt increase by more than an order of magnitude reaching a maximum level of 12.8 ppb over the general level of < 1 ppb in the section. The profiles of other elements show some interesting correlations with Ir. The siderophiles Fe, Ni and Co, as well as the rare earths, all show a peak at the boundary and a direct correlation with iridium. Ca and Ba, on the other hand, show a prominent decrease at the boundary with a general anti-correlation with the iridium concentration. The X-ray diffraction pattern of the brown iridium-rich layer from which sample B6b was collected shows a virtual absence of crystalline minerals, indicating that most of the material may be amorphous. Even common silicate minerals such as quartz, mica and calcite, which are abundant above and below this layer are absent or occur at minor trace levels. Further studies are in progress to characterize the material of the iridium-rich layer.

The pattern of enrichment of iridium and other siderophiles and lanthanides together with depletion of calcium and barium in Um Sohryngkew section is similar to the observed patterns at the K/T boundary clay-limestone sequence at Gubbio[1,6] but quite different from the behaviour found at Stevns Klint and Carvaca[6]. In the latter two sites enrichment of iridium and other siderophiles at the K/T boundary is accompanied with depletion of rare earths and calcium. The fractionation of rare earths may thus be governed by local, terrestrial conditions or may alternatively be an artifact of poor depth resolution since in Stevns Klint and Carvaca, a significant enrichment of rare earths does occur just above the K/T boundary.

We thus show the presence of a well-preserved K/T boundary section in the Sohryngkew river section with a prominent iridium enhancement where the geochemical pattern of the elements is

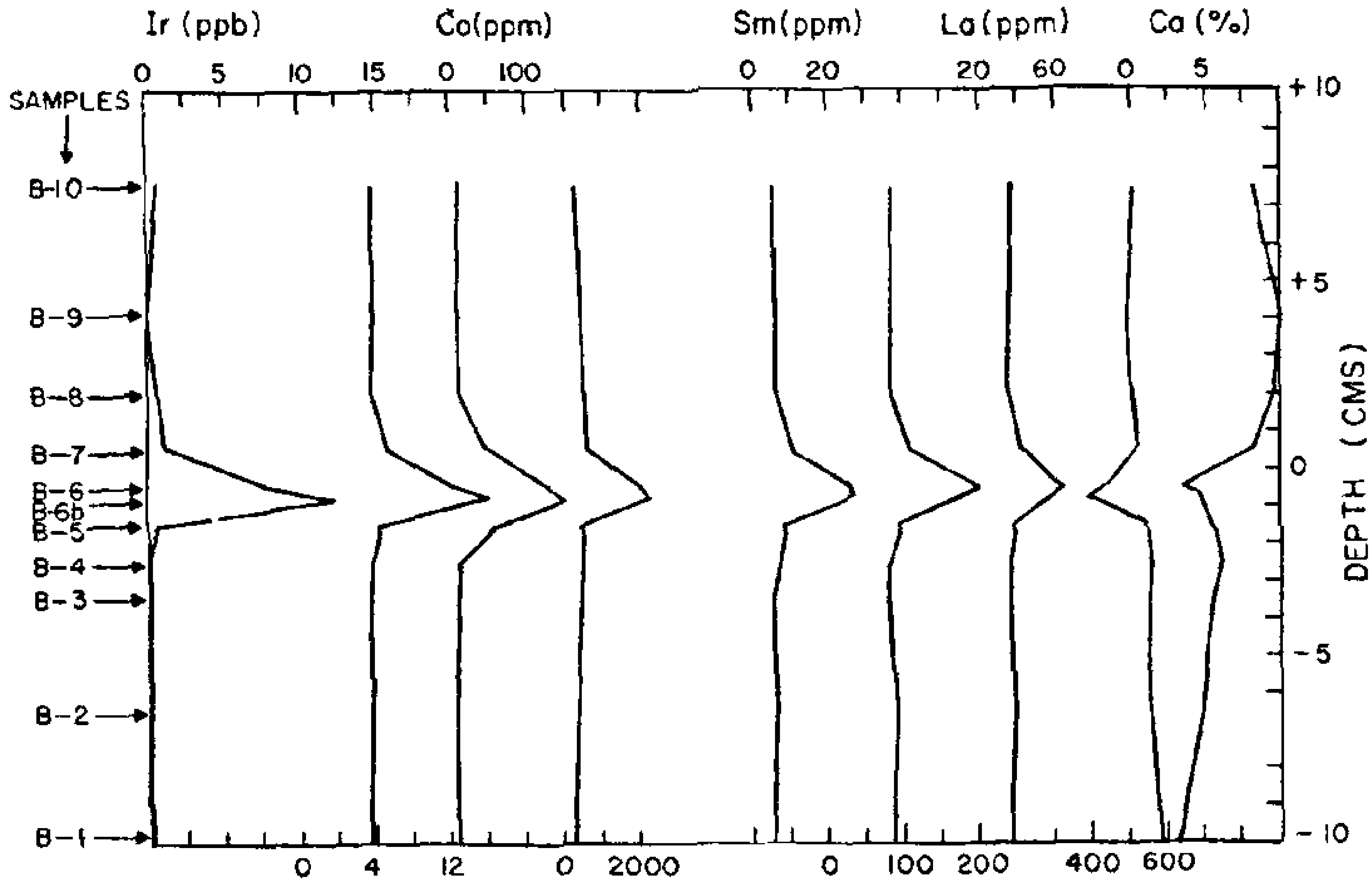

Figure 1. Profiles of Ir, Fe, Co, Ni, Sm, Ce, La, Ba and Ca across the Sohryngkew river K/T section. Clear enhancements of siderophiles and rare earths in samples B6 and B6b can be seen which is associated with depletion of Ca and Ba.

similar to the well established behaviour at Gubbio[1-6]. Since most sites have been confined to European and American continents, the presence of this anomaly in the eastern Tethys, where no observations have been made so far, support the global nature of the iridium enrichment. The fallout flux of iridium at Um Sohryngkew river site is estimated to be 40 ng/cm^2. This yields a chondritic fallout of 60 mg/cm^2. These values are similar to fallout at Gubbio but a factor of 2–4 lower than the values observed at Stevns Klint and Carvaca.

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