The study of basaltic magma eruption at the Tor Zawar, Ziarat, Pakistan

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The unusual report that on 27 January 2010 a small eruption of basaltic lava occurred at Tor Zawar, Ziarat, 75 km NE of Quetta, Pakistan, was extremely surprising because no eruptions from this magmatically inactive area had ever been reported. Two petrographically distinct basalt types were indentified in the vesicular eruptive products. Preliminary investigation of the mantle melt modeling suggested that the lavas had been largely derived from a source in the garnet-spinel transition zone, i.e. well within the lithosphere. It was proposed that localized asthenospheric melting resulted in relatively depleted melts, which were substantially contaminated by fusible lithospheric mantle en route to the surface; and that re-melting of local basaltic rocks by short circuiting of a ruptured high-tension electrical cable was unlikely.

However, our further investigation lead us to discover two more occurrences of similar nature; the 2nd at Tor Zawar, Ziarat District, only 300 m apart from the first event, and 3rd at Jang Tor Ghar, Muslim Bagh, Pakistan. The 2nd event of Tor Zawar, Ziarat occurred sometime during the month of January 2011 and the 3rd event of Jang Tor Ghar, Muslim Bagh on 12th February 2011. The site of all three are near the base of steel pylons, and earthing cables, supporting high-voltage overhead electric transmission line installed at the hillside outcrops, which acted as means to transmit atmospheric lightning at the outcrop. At the Tor Zawar, Ziarat District, the steel pylons are installed at the outcrops of the volcanic conglomerate of the Late Cretaceous Bibai Formation, whereas, in the Jang Tor Ghar, Muslim Bagh, within the alluvium mostly comprising ultramafic fragments of the Muslim Bagh Ophiolites. The lightning strikes transmitted enough energy to partially melt the outcrops and alluvium at the base of steel pylons, which solidified to produce light brown to black coloured basaltic glass of highly vesicular to moderately vesicular nature. Field evidence and the textural, petrographic and geochemical characteristics of the samples from these 'flows' lead us to reject the earlier proposal that these were magmatic events involving material derived from deep crustal or mantle sources. Instead, we conclude that these materials resulted from localised melting of basaltic clasts within volcanic conglomerates of the Bibai Formation. The melting was induced by discharges on to the rock surface of lightning that had been transmitted through steel supporting pylons and earth wires of the overhead transmission line. We also conclude that these products of partial surface melting were generated in a manner similar to that responsible for creating rock-fulgurites.