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Origin of Pseudotachylyte: A case study from the fault zone between the Mangalwar and Sand Mata plutons, central Rajasthan, India

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Pseudotachylytes are usually considered as brittle deformation products, recording paleoseismic zones, though it often occurs in granite or gneiss hosted ductile deformation zones [1,2]. The discontinuous thin bands of pseudotachylyte are developed in granitic mylonites on meters scale in central Rajasthan, India and extend along the NNE-SSW fault contact between the Mangalwar and Sand Mata plutons of the banded gneissic complex (BGC). The pseudotachylyte zone runs in the vicinity of the Delhi Fold Belt (DFB) / BGC tectonic front (NNE-SSW), and the deformation structures in the host mylonitic gneisses stand for its temporal relation with the movement along the latter front. The shear sense deduced from the Delhi Supergroup quartzite and BGC augen schist, adjacent to the DFB / BGC front, and the kinematic clue from the conjugate shear bands in the BGC mylonites collectively point that the tectonic activity along the DFB / BGC front took place under the regional ESE-WNW compression. The pseudotachylyte zone of central Rajasthan appears as an outcome of the cumulative effect of pre-, syn- and post-development of the shear bands (C' planes) in conjugate sets, and under the same regional compression.

The host rocks of the pseudotachylytes are garnetiferous granitic mylonites / ultramylonites, locally which also record cataclasis. Based on orientation relative to the host rock foliation and cataclasite bands, the pseudotachylyte bands and veins have been classified into (i) parallel to mylonitic foliation, (ii) oblique to mylonitic foliation, and (iii) associated with cataclasite. The textures and microstructures including flow banding, chilled margin, embayed margin of the clasts, confirm frictional heat induced melting origin of these central Rajasthan pseudotachylytes. The generation surface for melting was either mylonitic foliation or shear band or both. However, the meso- and micro-scale structures including pinch-and-swell structure, co-folding of the veins with the mylonitic bands and development of shear band across the vein/host contact witness that the pseudotachylyte bands and veins of type (i) and (ii) were produced over the period of pre- to syn-mylonitization of the host BGC rocks. The sense of shearing along the conjugate shear bands indicates the prevailing ESE-WNW compression. The central Rajsthan pseudotachylyte veins thus formed at brittle-ductile transition where the amphibolite facies mineral assemblages of the BGC rocks were developed at > 450º C temperature and > 11 km depth. The grain-size analysis indicates non-fractal nature of distribution. Of course it appears as possible result of underrepresentation of the smallest fraction [3].

The pseudotachylyte patches associated with the host rock cataclasites are, on the other hand, highly irregular in shape, fractured and locally show interfingering with the cataclasite, confirming shallow crustal origin. Moreover, development of conjugate shear fractures in the later pseudotachylyte patches points to exhumation under the prevailing ESE-WNW regional compression. It is thus apparent that the generation of the Rajasthan pseudotachylytes proceeded in two stages, initially at brittle-ductile transition and after exumation in the brittle regimes.

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