# Genesis of Pseudotachylyte vein from Gangavalli shear zone and its implication to the evolution of Attur valley, Tamil Nadu, South India.

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**Abstract:** Major part of peninsular India is endowed by Archean and Proterozoic rock possessing evolutional history of Indian continent both in terms of structural as well as metamorphically favored. LANDSAT imagery data analysis by Drury and Holt (1980) gives a clear cut idea of two major domains of geochronological and geologically separated as northern Archean granulite and southern Neoproterozoic granulite. These two granulite terrains in the southern part of India are offset along E-W running low angle dextral ductile thrust by dextral movement along Moyar-Bhavani-Salem-Attur shear zone. The so called Salem-Attur shear zone is documented as the eastern extension of Moyar-Bhavani shear zone (Drury et al., 1984; Chetty, 1996; Raith et al., 1999; Bhadra, 2001; Ramakrishnan, 2003; Jain et al., 2003; Satheesh kumar and Prasannakumar, 2009). The attitude of Salem-Attur shear zone has been a heated discussion among the researchers where some of intellectual people consider it as a fault (Srinivasan, 1974), an aulocogene (Katz, 1978), as a suture (Gopalkrishnan, 1996; Mukhopadhyay et al., 2003; Rao and Prasad, 2006) or a low angle thrust (Biswal et al., 2008). Such conflict arises due to exhibiting of both opposing shear sense in microscopic and macroscopic scale (Satheesh kumar and Prasannakumar, 2009), multiple tectonothermal events (Santhosh et al., 2003) and multigenerational folding structures observed in small scale and large scale (Biswal et al., 2010). However, ample investigation through kinematic prospective apprises a transpressional dextral strike slip shear zone which is later developed a vertical movement producing multiple interference fold pattern at some locality near Sarkar Nattar Mangalam (Biswal et al., 2008, 2009; Satheesh kumar and Prasannakumar, 2009; Bhadra, 1999; Drury and Holt, 1980; Valdiya, 1998). Many ductile driven NE oriented small scale mylonite/ultramylonite zones are developed which are considered to be the splay of regional E-W trending shear zone. Within the shear zone, a very remarkable change from mylonite to ultramylonite is observed in granitic gneissic outcrop. Granulite terrains are high resistance to erosion that results into high standing hills in the southern India with cutting by NE-EW-NW trending lineaments. The major litho units comprise charnockite and quartzo-feldspathic gneiss of neo-archean to Paleoproterozoic (Sundarlingam, 2013), Proterozoic mafic and ultramafic intrusion, Meso-proterozoic pseudotachylyte vein (Bhaskar Rao et al., 2006). The study area Attur valley is having conjugate fracture along NNW and NNE produces a compression along N-S direction. Two nearly parallel running E-W fault plane creates the north and south demarcation of the area cross cutting with Vellar fault and Sweta Nadi fault respectively (Fig.1.). Less weathered high standing charnockite hills on both north and south of Attur makes it a valley land form. Srinivasan (1974) has well documented that north dipping Vellar fault and south dipping Sweta Nadi fault has thrusted charnockite up to the upper crust. The oblique slip along thrust plane has a minor shifting of the Attur valley to the east which are indicated from the dykes and fault displacement at the out crop.

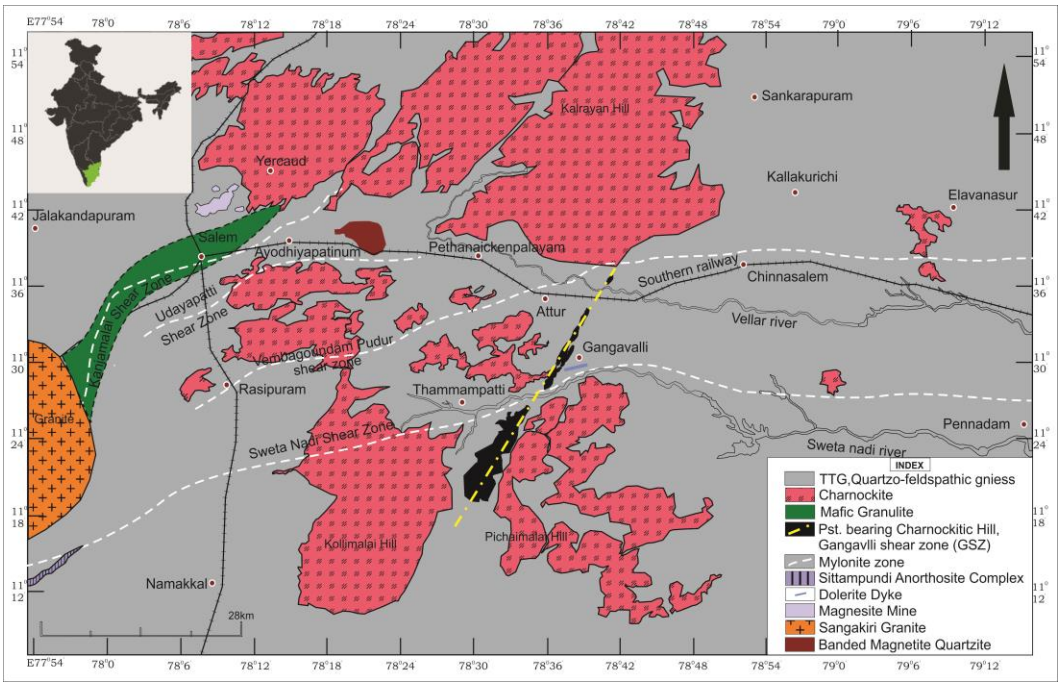


Fig.1. Geological map of Gangavalli shear zone (modified after Sundaralingam, 2013). Gangavalli shear zone is marked with yellow longer dashed line. This NE-SW trending hills are pseudotachylyte zone within the charnockite rock.

The so called pseudotachylyte rock was first discovered by Shand in 1916 in the Parijs area of South Africa, these are associated within the Vredefort Dome structure, a largest meteoric impact structure on the Earth surface. There are many approaches in the generation of pseudotachylytes. But two major approaches are noticed in a broad scale impact melting (Grieve 1975; Reimold and Colliston 1992; Spray and Thompson 1995) and frictional melting (Sibson 1975; Cardwell et al. 1978; Spray 1992; Swanson 1992; Bizzarri 2014). A pseudotachylyte zone of wide 100 m and elongation 20-25 km is obtained which runs along NE-SW direction with comprising five charnockite hills. These hills are well recognized for study of pseudotachylyte vein and also exposed along two parallel running Vellar river and Sweta nadi river at north as well as south of Attur Valley. These dark aphanitic pseudotachylyte veins are varying in size in order of millimeter to centimeter thickness. Veins with very less thickness produce more branching out network structure whereas thicker veins are more undulose. Injected veins at some places are orthogonal to the gneissic foliation of the country rock and at other places these are parallel. The injection of melt within the gneissic plane suggests that the onset melting of pseudotachylytes are either more fluidized or the intrusion pressure must be too high for melt propagation. If it is the later case then stress of the injected melt has to overcome the stress of the gneissic plane so that opening can be produced to accumulate the pseudotachylyte melt within the foliation plane. Small scale displacements (e.g. < 1 cm) of quartz vein as well as pseudotachylyte veins indicate both sense of shear in the same locality. This may be considered as one of the supportive evidence of strike slip shearing in the area. Further evidences are gathered from microscopic

study which suggests that displacement has taken places along both the orientations of a conjugate fracture in the same thin section. Hence, from field observation and petrographic analysis of both host rock as well as pseudotachylyte vein, we interpreted that a fast slip rate strike-slip brittle deformation within Attur valley has been the cause of pseudotachylyte melts formation. The cross cutting of NE-SW trending pseudotachylyte zone over two parallel running E-W faults (e.g. Vellar fault and Sweta nadi fault) indicates the younger age of Gangavalli shear zone (Fig.1.).

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