

Research Statement (max. one page)

By Dr. Bhuban Mohan Behera

I am a structural geologist (Ph.D., Indian Institute of Technology Bombay). I enjoy deciphering the process involved during rock deformation and its resulted products. One such product is dark glassy rock melt, known as pseudotachylite. Pseudotachylite, being rarely occurring and associated with seismic fault plays an important role as a direct seismic indicator which makes it a unique and unconventional one. Melting due to high-speed friction along the fault interface causes the generation of pseudotachylite melt. The study of pseudotachylite and its incorporation with fault rocks have fascinated many earth scientists for more than a century and me from my early career of research. Recently, synthetic pseudotachylite produced through frictional apparatus in the laboratory environment has changed the way we look at the mechanism of pseudotachylite origin and the strength of post-faulting rock. Therefore, the compositional analysis of this melt has become an important aspect to decipher the kinematics of seismic-related fault. But the biggest challenge in this study is faced due to the interfering of country-rock fragments in the analysis. So, at most care is needed for consideration of both clasts as well as the matrix of pseudotachylite. These clasts bear evidence of the melting effect and the maximum temperature attended during friction. Furthermore, the thermal energy and the mechanical stresses are also shared by these clasts that are present within the pseudotachylite vein. Therefore, it requires more research to focus on the incorporated clasts, which ultimately contribute to the gross composition and strength of the pseudotachylite body.

In light of these research objectives, my research program comprises of size distribution, roundness study, and chemical analysis of clasts and their relationship with the surrounding country rock. The use of the above studies has several advantages to decipher the process and the product involved during the deformation of the rock in a brittle condition. Firstly, the size distribution explains the process of rock fragmentation during friction along with the fault interface. Secondly, the roundness study indicates the involvement of the melting process which produces pseudotachylites, and the temperature achieved by the friction. Finally, the chemical composition of clasts and matrix and surrounding rocks shows that a selective melting of mineral is preferred that dominates the pseudotachylite composition. Broadly, the above research contributes to the evolutionary history of the Southern Granulite Terrane of India and correlating it globally with the Columbia accretion period through the dating of pseudotachylite. Further, there is more scope to research in the field of fault generated pseudotachylite; particularly its role in the strength variation of post faulting rocks.

The outcomes of my research work are justified by publishing in the SCI journals and presenting in various conferences (India/abroad).

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EDUCATION

- 2020 **Indian Institute of Technology, Bombay (IIT Bombay)**
Ph.D., Structural Geology
Thesis: Tectonic setting of pseudotachylite from the Gangavalli Fault Zone and its implication on the evolution of the Southern Granulite Terrane, India.
Advisor: Prof. Tapas Kumar Biswal (IIT Bombay)
- 2014 **Indian Institute of Technology, Bombay (IIT Bombay)**
M.Sc., Applied Geology (7.72 CPI)
Department of Earth Sciences
Thesis: Study of pseudotachylite around the Gangavalli Fault Zone (GFZ), Salem, Tamil Nadu.
Advisor: Prof. Tapas Kumar Biswal (IIT Bombay)
- 2011 **Ravenshaw University, Odisha**
B.Sc., Department of Geology (75.3%)

PROFESSIONAL APPOINTMENTS

- 2020 **Indian Institute of Technology, Bombay (IIT Bombay)**
Mar-Sep *Research Associate*

RESEARCH OVERVIEW (Max. five lines)

Investigating the origin, structural and tectonic significance of linearly occurring pseudotachylite zone on the evolution of the Southern Granulite Terrane (SGT) in Tamil Nadu, India through geochemical analysis, kinematic study, paleostress calculation, fluid pressure study, earthquake source properties, strength analysis of fault zone rocks, and geochronological study. Results indicate a strike-slip set up during Columbian supercontinent tectonics and may represent marginal tectonics which leads to the future research scope.

ACADEMIC ACHIEVEMENTS

- 2012 Qualified IIT-JAM Geology & Geophysics, All India Rank-105 conducted by IIT Bombay.
- 2011 Merit Scholarship from Institute of Mathematics and Application (IMA), Bhubaneswar, Odisha.
1st rank in Geology Entrance 2011 (Admission to Master's degree) conducted by Utkal University, Bhubaneswar, Odisha.
Medhabruti Scholarship by Department of Higher Education (DHE) Odisha.

PUBLICATIONS

(A) Peer-reviewed SCI Journals

*Corresponding author

- 2022 **Behera B.M.***, Tripathy A. and Biswal T.K. Strength enhanced by pseudotachylite melt in fault zone rocks during post-seismic melting: a case study from the Gangavalli fault zone, Southern India. *Journal of Earth System Science*. 131(4), 1-15. <https://doi.org/10.1007/s12040-022-01960-8>.

Biswal T.K.*, Pradhan R.M., Sharma N.K., Tiwari S.K., Beniast A., **Behera B.M.**, Singh S., Saraswati R., Bharadwaj A., Umasankar B.H., and Singh Y.K. A review on deformation structures of different terranes in the Precambrian Aravalli-Delhi Mobile Belt (ADMB), NW India: Tectonic implications and global correlation. *Earth-Science Reviews*. 104037. <https://doi.org/10.1016/j.earscirev.2022.104037>

Mishra P.K., **Behera B.M.*** and Mahapatro S.N. Clast size analysis of pseudotachylite co-existing with mylonite: Constraints on evolution of Mahanadi Shear Zone, Eastern Ghats Mobile Belt, India. *Journal of Earth System Science*. 131(2), 1-13. <https://doi.org/10.1007/s12040-022-01856-7>.

2020 Meher B., **Behera B.M.*** and Biswal T.K. Dynamic recrystallization mechanisms and vorticity estimation of Terrane Boundary Shear Zone (Lakhna shear zone): Implications on dynamics of juxtaposition of Eastern Ghats mobile belt with Bastar craton, NW Odisha. *Journal of Earth System Science*. 129, 124. <https://doi.org/10.1007/s12040-020-01393-1>

2019 **Behera B.M.***, Waele B.D., Thirukumaran V., Sundaralingam K., Narayanan S., Sivalingam B. and Biswal T.K. Kinematics, strain pattern and geochronology of the Salem-Attur shear zone: tectonic implications for the multiple sheared Salem-Namakkal blocks of the Southern Granulite terrane, India. *Precambrian Research*. 324, 32-61. <https://doi.org/10.1016/j.precamres.2019.01.022>

2017 **Behera B.M.***, Thirukumaran V., Soni A., Mishra P.K. and Biswal T.K. Size distribution and roundness study of clasts within Pseudotachylytes of the Gangavalli Shear Zone, Salem, Tamil Nadu: an insight to its origin and tectonic significance. *Journal of Earth System Science*. 126(4), 46. <https://doi.org/10.1007/s12040-017-0827-x>

(B) Manuscript in preparation/submission/under review

Review on pseudotachylite from Indian subcontinent (in the oven).

(C) Proceedings/Book Chapters

2020 **Behera B.M.**, Thirukumaran V., Sharma N.K. and Biswal T.K.* A preliminary study on Earthquake source properties based on geochemistry, shear resistance and melt pressure of pseudotachylites, Gangavalli fault, South India. In: *Structural Geometry of Mobile Belts of the Indian Subcontinent*. Springer, Cham. 175-197. https://doi.org/10.1007/978-3-030-40593-9_8

(D) Presentations (National/International conferences)

*Presenting author

2021 **Behera B.M.*** Tripathy A. and Biswal T.K. Strength evolution in fault rocks during pre-and post-seismic melting: the Gangavalli fault zone, Southern India. *Tectonic Studies Group (TSG)@50 AGM 2021: Virtual Meeting*, 5-8 January 2021. (Abstract volume)

2018 **Behera B.M.*** and Biswal T.K. Interchangeable stress condition inferred from paleostress analysis of pseudotachylite vein emplacement from Gangavalli (Southern India). *5th Conference and workshop on Rock Deformation and Structures (RDS-V)* Delhi. 4-6 October 2018. (Abstract volume)

Behera B.M.*, Tripathy A. and Biswal T.K. Pre- and post-seismic strength variation of melt associated fault rock from Gangavalli shear zone: a reappraisal study using point load test and petrography study of pseudotachylite vein. *American Geophysical Union (AGU) Fall Meeting 2018 Virtual Poster Showcase*, Washington D.C. USA, Dec.10-14. (Abstract volume)

Behera B.M.* and Biswal T.K. Paleostress analysis from Gangavalli (southern India): inferred from pseudotachylyte emplacement and fracture data. *National Seminar on Effects of Paleo and Anthropogenic events of Earth System & Annual General Meeting (AGM)-2018 of Geological Society of India*. Sept. 19-21. (Abstract volume)

2016 **Behera B.M.***, Biswal T.K. and Thirukumaran V. Breakneck frictional melt from Gangavalli shear zone, an eastern part of regional Salem-Attur shear zone, Tamil Nadu: an evidence of strike-slip brittle deformation. *Annual General Meeting of the Geological Society of India*, 2016. 58-60. (Abstract volume)

Behera B.M.*, Thirukumaran V. and Biswal T.K. Brittle deformation in Southern Granulite Terrane (SGT): A study of pseudotachylyte bearing fractures along Gangavalli shear zone (GSZ), Tamil Nadu, India. *European Geosciences Union (EGU) General Assembly 2016*, Europe, Vol.18, EGU2016-18128. (Abstract volume)

FIELD TRAINING AND WORKSHOP

- 2020 e-Training on “Basic course on Arc GIS and its application for RMT” by GSI.
- 2016-20 Structural field in and around Ambaji area, Gujarat.
- 2014-20 Structural fieldwork in and around the Salem-Attur area, Tamil Nadu.
- 2018 Workshop on Introduction to Digital Mapping Techniques at Department of Geology, University of Delhi, Delhi, India.
- 2013 Summer Industrial Training at Hindustan Copper Limited (HCL), Malanjkhand Copper Project, Madhya Pradesh.
- 2012 Structural field training in Kutch, Gujarat.
- 2011 Specialized Training in Structural Mapping in Complex Precambrian Terrain. Sambalpur University, Odisha.

ANALYTICAL PROFICIENCY

Petrological Microscope, Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP-AES), XRD, Atomic Absorption Spectroscopy (AAS).

PROGRAMMING AND SOFT COMPUTING

Tools and Software: Corel DRAW(X8), MatLab (beginner), ArcGIS (beginner), AutoCAD 2011, OriginPro2016, Stereonet 9, Win_Tensor 5.9, PetroGraph 2.0, ImageJ, EllipseFit_3.4.0 and MS Office.

Operating system: Linux, Windows, XP, 7, 8, and 10.

PROFESSIONAL AFFILIATIONS

Geological Society of India, Bangalore • Geological Society of America, USA • European Geosciences Union, Austria • American Geophysical Union, USA

EXTRACURRICULAR ACTIVITIES

- 2014 General Championship (GC) of intra-IIT Bombay.
- 2013 Volunteering in SAHAYOG, an initiative by IIT Bombay to help Phailin and Flood victims in Odisha.
- 2005 Sports Champion in Annual sports organized by Dhakotha High School, Keonjhar, Odisha.

Played kho-kho in the district-level sports championship, Odisha.

LANGUAGE PROFICIENCY

English (Reading, Writing and Speaking), Hindi (Reading and Speaking), Odia (Reading, Writing and Speaking), Bengali (Can understand)

HOBBIES

Collection of geological samples, Swimming (Freestyle and backstroke), Skating (Inliner), Gardening and farming.

TEACHING EXPERIENCES

Methods in Structural Geology (GS687) • Tectonics and Crustal Evolution (GS534)

REFERENCE (S)

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