

Recent Trends and Techniques in the Study of Brittle Deformation: Implications in Upper Crustal Fluid Flow

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A two days' workshop entitled "Recent trends and techniques in the study of brittle deformation: Implications in upper crustal fluid flow" was held in the Geological Studies Unit of Indian Statistical Institute, Kolkata from 13th to 14th September, 2023. It was organized by the Geological Studies Unit and was convened by Dr. Tridib Kumar Mondal (Indian Statistical Institute, Kolkata) and co-hosted by Prof. Susanta Kumar Samanta (Jadavpur University, Kolkata). The workshop brought together 45 participants from different parts of the country.

The Geological Studies Unit (GSU) at the Indian Statistical Institute (ISI), Kolkata was established with the vision of expanding the role of statistics in geosciences and fostering a symbiotic relationship with various academic disciplines. GSU's research endeavors encompass tectonics, structural geology, sedimentology, geochemistry, paleo-biodiversity and biotic evolution to reconstruct the earth's geological history and paleoclimate.

In pursuit of these goals, GSU aimed at organizing the above-mentioned hands-on workshop. Brittle deformation of materials entails the type of deformation that leads to the disruption or discontinuity of a material, either internally or externally. It serves as a crucial topic for geologists who are engaged in paleostress estimation, mineral exploration, hydrocarbon exploration, earthquake studies, volcanology, hazard mitigation and other associated activities. However, there has been a notable lack of research in this field, particularly in India. This gap in knowledge and understanding has been the driving force behind organising this workshop. This workshop served as an excellent opportunity for training and interaction with participants, especially young students (M.Sc.) and researchers (Ph.D.) who will play a vital role in advancing geoscience in the years to come, in both fundamental and contemporary concepts of brittle deformation. The workshop was sponsored by ISI Kolkata and MoES, GoI.

The workshop was inaugurated by the hon'ble Director of the Institute (Prof. S. Bandyopadhyay), Prof. In-Charge, Physics and Earth Sciences Division (Prof. P. Ghosh) and Head of the Unit (Dr. Shiladri S. Das). Prof. Dhrubajyoti Mukhopadhyay (Raman Centre for Applied and Interdisciplinary Sciences, Kolkata) was the chief guest of the workshop. The work-

shop started with two key note lectures: (1) Controls on fluid flow in the upper and lower crust (Prof. Saibal Gupta, IIT Kharagpur) and (2) Crustal fluid flow: The role of chemical reactions (Prof. Pulak Sengupta, Jadavpur University, Kolkata) followed by three sessions on the first day: (1) Introduction to brittle deformation (Dr. Tridib Kumar Mondal), (1A) Mechanisms of Dyke Formation & Emplacement; Magma Overpressure & Depth of Origin of Dykes, and (1B) Fracture Networks and their Characterization (Mr. Sirshendu Kumar Biswas and Dr. Tridib Kumar Mondal, ISI Kolkata). Participants had a visit to the esteemed geological museum of the institute at the end of the first day. The second day started with briefing of day one and was followed by three more sessions: (2A) 3D Mohr Circle and Fluid Pressure estimation (Dr. Tridib Kumar Mondal), (2B) Modelling of brittle deformation: scopes and limitations (Prof. Susanta Kumar Samanta), (3) Paleostress analysis - Theories and Techniques (Mr. Gourav Das, Dr. Tridib Kumar Mondal and Ms. Damayanti Choudhury, ISI Kolkata). The detailed technical issues associated with brittle deformation and their applications were discussed after every session. The discussions brought to light several interesting points such as: (a) quantification of paleostress, (b) mixed mode fractures, (c) issues related to thermal fracturing, (d) modelling deformation. A number of pre-collected data sheets were provided to the participants and hands-on training was given with the help of softwares related to brittle deformation. A Workshop Manual compiling the basic outline of the sessions along with pertinent references was provided to all the participants. Finally, the workshop was concluded by a motivating talk on future scope in geosciences in India (Prof. Somnath Dasgupta, INSA Senior Scientist, ISI Kolkata) followed by distribution of certificates to participants and vote of thanks.

