

Thesis Abstract

Thesis title: New Applications of Thermo-luminescence: Dating of Paleoseismic Events and Pedogenic Carbonates

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The present thesis aimed at the development of luminescence techniques for providing a chronology of important geological processes, viz., paleoseismic events and carbonate formation periods.

1. Dating of Paleoseismic Events

A luminescence method for dating fault gouges was devised for the first time. The method assumes that faulting resets the geologically acquired luminescence of the fault gouge. This assumption was tested in various experiments. Studies on the dependence of luminescence age with the size of the gouge grain suggested that a plateau in luminescence ages below a certain critical grain size is a good indicator of complete resetting of the luminescence signal. Observation of substantially higher host rock paleodoses in comparison to fault gouges also suggests efficient resetting of luminescence during faulting. After the feasibility studies, fault gouges were collected from various Himalayan faults, viz., Nainital Fault, Sleepy Hollow Fault, Mohand Thrust and the Main Boundary Thrust. The luminescence analyses suggest the occurrence of neotectonic activity at the Nainital Fault and the Sleepy Hollow Fault at 41 ± 8 ka and 36 ± 5 ka. The Mohand Thrust was active at 59 ± 10 ka ago while tectonism is indicated along the Main Boundary Thrust (Nainital region) at 70 ± 12 ka. The luminescence ages are consistent with available ^{14}C formation ages of lakes created by faulting in these regions.

A second approach to date seismic events was the development of optical dating of seismites (overbank river/lake sediments deformed by earthquakes soon after deposition). This method assumes that the seismites have insignificant accumulated luminescence at the time of the earthquake. Seismites were collected from a

modern seismically active site, Sumdo Valley, Himachal Pradesh, India. The luminescence ages of these seismites imply that seismic events occurred in Sumdo at ~ 90 ka, 61 ka, 37 ka and 26 ka.

2. Dating of Pedogenic Carbonates

The first practical luminescence method to date carbonates utilized changes in the dose-rate to mineral grains during their formation. The age of the carbonate is evaluated by dividing the difference of paleodoses to the mineral grain from the ambient sand and carbonate by the difference between the sand and carbonate alpha and beta dose-rates. The new method is less susceptible to post-depositional changes compared to ^{14}C and U-series disequilibrium methods. Carbonates were sampled from various sites in Thar Desert across an east-west transect of ~ 300 km. Luminescence ages are observed to be stratigraphically consistent and indicate that carbonate formation took place in Thar at ~ 100 ka, ~ 17 ka and ~ 2 ka. The carbonate formation periods suggested by the luminescence chronology were consistent with the epochs implied by local paleoclimatic data.