Pseudotachylytes, related fault rocks, asperities, and crustal structures in the Hidaka metamorphic belt, Hokkaido, Japan

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Many pseudotachylytes and their related fault rocks are found in the Hidaka metamorphic belt representing an ancient crustal section. On the basis of field observations of the pseudotachylytes and related fault rocks, nature of seismogenic faulting in the Hidaka crust is examined. The field observations and spatial distribution of the Hidaka pseudotachylytes suggest the following conclusions. (1) Two structural types of pseudotachylytes are distinguished: layer-parallel and layer-oblique pseudotachylytes. The latter are scattered in the metamorphic belt, but the former occur only in the southern part of the metamorphic belt. (2) An abundance of the layer-parallel pseudotachylytes suggests that earthquakes occurred repeatedly and frequently in the southern part, where complicated and duplicated crustal structures occur together with many low-temperature thin mylonite zones. The southern part with such crustal structures was an ancient seismogenic or earthquake rupture area containing asperities and having a radius of a few tens of kilometers in the Hidaka crust. In the seismogenic area, the layer-parallel pseudotachylytes resulted from seismic slip on the mylonitic foliation within the low-temperature thin mylonite zones that have acquired strong preferred orientation of micas. The mode of occurrence of the layer-oblique pseudotachylytes suggests that small seismogenic areas along the conjugate vertical strike-slip faults were scattered in the metamorphic belt, and that the pseudotachylyte-producing seismic faulting occurred repeatedly under the brittle regime.

(3) The layer-parallel pseudotachylytes and the subsequent layer-oblique pseudotachylytes post-date the latest and very-low-temperature mylonitization in the metamorphic belt. The formation of the layer-parallel pseudotachylytes may have been enhanced and controlled by enrichment in biotite not in the major thick mylonite zones but in the later low-temperature thin mylonite zones of the southern part of the metamorphic belt. Mode of occurrence of the layer-parallel pseudotachylytes along strong mylonitic foliation with cataclasites suggests that the rupture and melting processes have occurred at the bottom of upper crust on the top of the brittle-plastic transition zone.