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Fault rock weakening mechanisms along plate-boundary faults: insights from the Median Tectonic Line, Japan

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The Median Tectonic Line (MTL) in SW Japan separates a low-P/high-T belt of abundant granitoids with subordinate metasediments (Ryoke Belt) from high-P/low-T accretionary complex metasediments (Sambagawa Belt). The fault has been active since mid-Cretaceous with estimated, mainly sinistral displacements of at least several tens of km. Fault rock exposures in the core of the MTL preserve a history of movements at a range of mid- to shallow-crustal levels. Ryoke Belt rocks are variably mylonitized in a zone 1-2 km thick N of the MTL and preserve typical greenschist-facies textural assemblages formed during Cretaceous top-to-south sinistral movements. The remainder of the fault zone (the 'core' region) is up to 60m wide and displays a wide variety of fault rocks mostly derived from Ryoke protoliths. In the core, the following progressive sequence of fault rock overprinting is recognised: mylonite/ultramylonite → cataclasite → foliated cataclasite → phyllonite (here defined as a phyllosilicate-rich fault rock with *apparently* mylonitic textures). Textural and geochemical relationships suggest that this sequence results from the syn-kinematic influx of a chemically active fluid phase into the more permeable, finer grained parts of the fault zone immediately following cataclasis. Thus the foliation develops initially along pre-existing brittle fault zones and forms due to the effects of fluid-assisted reaction softening (retrograde growth of sericite, chlorite) combined with the onset of widespread diffusive mass transfer (solution seams, fibrous overgrowths). The foliated cataclasites/phyllonites

preserve textures almost identical to those produced in recent analogue experimental studies designed to assess the effects of fluids and phyllosilicates in fault zones. These studies predict a marked long-term weakening effect and this is consistent with the observed localisation of all subsequent movements into the narrow foliated core of the MTL. Our findings suggest that the extensive development of phyllosilicate foliations overprinting cataclasites in fault core regions may be a primary geological indicator of long term weakening.