

Seismicity and mineral destabilizations in the subducting mantle up to 6 GPa, 200 km depth

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In the subducting oceanic lithosphere, a significant part of the seismicity is triggered in the mantle, especially along the upper and lower Wadati-Benioff planes. Several studies have investigated the potential involvement of dehydration reactions in the triggering mechanism of mantle earthquakes. Recent experimental results reveal that, under subduction conditions, mechanical instabilities nucleate in strong stable mineral aggregates during the destabilization of minor amounts of antigorite, i.e. the high-temperature serpentine, through a stress transfer, without any fluid overpressure. Here I confront these laboratory results to seismological observations. On one hand, most of the natural hydrous magnesium silicates seem to be known, with experimentally-deduced stability limits up to 7 GPa, at least, available as relatively accurate estimates. On the other hand, recent achievements in thermal structure of subduction zones combined with precise hypocentre relocation give access to pressure and temperature conditions at earthquakes hypocentres. A series of P-T diagrams summarizes the stability limit of minerals that may be part of natural peridotite with variable compositions at pressures from 0.5 to 6 GPa and temperatures from 200 to 950°C, and compares it with seismicity. Both hydrous and anhydrous phases are considered. A myriad of minor metamorphic reactions could participate in a transformation-driven stress transfer, even if the stability limits of serpentine minerals seem to correlate with most of the observed seismicity.

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