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Large Subduction Earthquakes along the fossil MOHO in Alpine Corsica: what was the role of fluids?

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Intermediate depth subduction earthquakes abruptly release vast amounts of energy to crust and mantle lithosphere. The products of such drastic deformation events can only rarely be observed in the field because they are mostly permanently lost by the subduction. We present new observations of deformation products formed by large fossil subduction earthquakes in Alpine Corsica. These are formed by a few very large and numerous small intermediate-depth earthquakes along the exhumed palaeo-Moho in the Alpine Liguro-Piemontese basin, which together with the 'schistes-lustrés complex' experienced blueschist- to lawsonite-eclogite facies metamorphism during the Alpine subduction. The abrupt release of energy resulted in localized shear heating that completely melted both gabbro and peridotite along the Moho. The large volumes of melts that were generated by at most a few very large earthquakes along the Moho can be studied in the fault- and injection vein breccia complex that is preserved in a segment along the Moho fault. The energy required for wholesale melting of a large volume of peridotite pr. m2 fault plane, combined with estimates of stress-drops show that a few large earthquakes took place along the Moho of the subducting plate. Since these fault rocks represent intra-plate seismicity we suggest they formed along the lower seismogenic zone by analogy with present-day subduction. As demonstrated in previous work (detailed petrography and EBSD) by our research team, there is no evidence for prograde dehydration reactions leading up to the co-seismic slip events. Instead we show that local crystal-plastic deformation in olivine and shear heating was more significant for the run-away co-seismic failure than a solid-state dehydration reaction weakening. We therefore disregard dehydration embrittlement as a weakening mechanism for these events, and suggest that shear heating may be the most important weakening mechanism for intermediate depth earthquakes.