Laboratory earthquakes triggered by metamorphic reactions during the eclogitization of blueschist

*Sarah Incel[1], Alexandre Schubnel[1], Nadège Hilairet[2], Timm John[3], Loïc Labrousse[4], Thoams Ferrand[1], Damien Deldicque[1], Yanbin Wang[5], Jörg Renner[6], Christian Chopin[1]

1.Ecole Normale Supérieure Paris, 24 Rue Lhomond, 75005 Paris, France, 2.CNRS-UMET, Université Lille, 59655 Villeneuve d'Ascq, France, 3.Freie Universität Berlin, Malteserstr. 74-100, 12249 Berlin, Germany, 4.Université Pierre et Marie Curie, 4 place Jussieu, 75252 Paris, France, 5.GeoSoilEnviroCARS, University of Chicago, Argonne,IL 60439, USA, 6.Ruhr Universität Bochum, Universitätsstraße 150, 44801 Bochum, Germany

The phenomenon of intermediate depth seismicity has been highly debated for several decades. The term dehydration embrittlement refers to one of the developed theories that specifically relates the formation of deeper earthquakes to the breakdown of hydrous phases in the subducting oceanic plate and in the hydrated mantle. Especially the dehydration of lawsonite in blueschists and eclogites is a potential candidate to explain the formation of those intermediate depth earthquakes in the down-going slab that represent the upper Wadati-Benioff plane of seismicity. It was recently shown that the breakdown of lawsonite triggers unstable slip accompanied by acoustic emissions (AE) while deforming the samples in the Griggs apparatus. Our experimental results reveal either one or two clusters of AEs depending on the confining pressure of the experiment while deforming natural lawsonite bearing blueschists under eclogite facies conditions. These clusters can be linked to two different metamorphic reactions: the growth of omphacite and garnet and/ or actinolite which liberates only minor amounts of water in expense of glaucophane and lawsonite under lower temperatures (300 –450 °C) and the reaction between lawsonite and glaucophane to clinozoisite, paragonite, and actinolite (+/- garnet) and water at higher temperatures (600 –850 °C). The experimental results indicate that more than one metamorphic reaction may trigger intermediate depth earthquakes at different stages during cold subduction of the oceanic crust.

Keywords: subduction zone, dehydration reactions, eclogitization

