Geophysical Research Abstracts
Vol. 15, EGU2013-5352, 2013
EGU General Assembly 2013

Methane generation in subduction zones: A cause for fluid overpressures?

Hugues Raimbourg (1), Jean-Robert Disnar (1), Regis Thiery (2), Claire Ramboz (1), Asuka Yamaguchi (3), and Gaku Kimura (4)

(1) Institut des Sciences de la Terre d'Orleans, UMR 7327, CNRS/Universite d'Orleans, Orleans, France (hugues.raimbourg@univ-orleans.fr), (2) Laboratoire Magmas et Volcans, UMR 6524, CNRS/Clermont Universite, Clermont-Ferrand, France, (3) Atmosphere and Ocean Research Institute, The University of Tokyo, Kashiwa, Japan, (4) Department of Earth and Planetary Science, The University of Tokyo, Hongo, Tokyo, Japan

The nature of the fluids involved in the deep plate interface in subduction zones is difficult to constrain, as it incorporates many potential sources (sea water trapped in pores, water from dehydration reactions, fluid from the depths of the subduction channel or from the slab). Using Raman analysis of fluid inclusions in quartz veins from the deep domains of the Shimanto paleo-accretionary complex, Japan, we first show that at temperatures of $\sim$250°C, the fluid is a mixture of water and methane, in agreement with literature on similar terranes. In most of the studied area, we could observe only one, water-rich, kind of inclusion, while in a restricted region a second, methane-rich, kind of inclusion was also present, suggesting in the first case the circulation at depth of a single fluid and in the second case the coexistence of two fluid phases.

We used then isochores of the methane-rich fluid inclusions to constrain the paleo- fluid pressure. In the present case, methane-rich inclusions are distributed as planes, i.e. along healed microcracks, hence they provide a record of the conditions that prevailed during a short period of time. Within a single plane of inclusions, homogeneization temperatures of the methane phase show large variations between inclusions, which we interpret as the record of large and rapid variations in fluid pressure.

To account for this diversity in the fluid state (single- vs. two-phased) as well as for the rapid variations in pressure, we developed a model of methane generation by thermal cracking of organic matter during burial. In spite of the low average organic matter content of subducted sediments, the porosity, hence the water content of deep sediments is sufficiently low for the oversaturation of the water in methane, hence unmixing of a free, methane-rich phase, to be a realistic scenario. Predicted overpressures resulting from rapid unmixing of methane can be significant with respect to ambient fluid pressure and constitute therefore a potential source for rapid drop in effective pressure, possibly resulting in seismic events. Finally, the evaluation of the potential to generate methane at depth over worldwide subduction zones shows that the classical distinction between aseismic, Marianna-type subduction zones and seismic, Chilean-type subduction zones coincides with a division between methane-poor and methane-rich subducted sediments.