Geophysical Research Abstracts
Vol. 20, EGU2018-18580, 2018
EGU General Assembly 2018

New discovery of silica-rich septarian concretions reveals importance of hydrothermal activity at fossil hyper-extended margins (Err nappe, Switzerland).

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In this study we investigate the origin of silica-rich septarian concretions occurring within the syn- to post-tectonic sediments of the fossil distal Adriatic rifted margin today exposed in the Err nappe (Central Alps). We propose that these unconventional diagenetic concretions may represent a new and powerful tool to recognize fossil fluid circulation in sediments from deep-water distal domains, i.e. from an environment where such concretions have never been described before. Strong field and petrographic evidence links their formation to the Early-Middle Jurassic extensional evolution of the fossil Alpine Tethyan margin. The siliceous composition of the concretion body and the authigenic saddle dolomite and quartz filling the cracks, represent a new discovery enlarging the spectra of possible septarian concretion types. Fluid inclusion temperatures (∼150°C), and the positive δ18O values for original fluids (up to +7‰ SMOW), point to a deep circulation of seawater into fault damage zones developed in the basement and to the upward flux through the sedimentary column. The anomalous, quartz-rich, mineralogy of the concretions fits with their location in a hyper-extended margin where low-angle detachment faults exhume a strongly altered basement, leading to an intense fluid-rock interaction and silica enrichment in the fluids. We propose that silica-rich fluids originated from convection cells of seawater penetrating deeply within fault-related fracture zones developed in the substrate of the basin. Fluids were heated, enriched in silica, and forced to flow upwards. Quartz-filled veins were generated while crossing coherent sediments, whereas silica-rich nodules formed in highly porous sediments close to the sea floor. We also suggest that hot and high-salinity brines mixing with interstitial seawater may cause shrinkage leading to septarian cracking. This study, then, aims to: i) describe a new type of silica-rich septarian concretion, ii) provide new constraints on their formation, iii) show that this particular type of siliceous septarian concretion can provide strong evidence for hydrothermal fluid flow in shallowly buried soft sediments with significant implications on the tectono-stratigraphic evolution of the sedimentary basin at the time of its formation.