Geophysical Research Abstracts
Vol. 20, EGU2018-8858-1, 2018
EGU General Assembly 2018

Early to Late Diagenetic and Transform Fault Overprint of Mesozoic Dolostones

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Dolomitic rock (dolostone), which is very common in the geological rock record, is extensively explored, but up to now it is strongly debated what kind of information can be gathered from diagenetic dolomite. This study aims at exploring the value of diagenetic dolostones representing complex archives of depositional and diagenetic features. Using combined fieldwork and laboratory techniques (petrography, isotope geochemistry), we disentangle the complex diagenetic succession and subsequent tectonic overprint of Mesozoic carbonates along the Neogene Carboneras Fault Zone in SE Spain in order to better understand post-depositional alteration and anchimetamorphic pathways. A suite of rock samples collected along the transform fault represents increasing stages of diagenetic and tectonic overprint. Transmitted light- and cathodoluminescence microscopy display several paragenetic phases of early to late stage dolomite. These include the (i) patchy luminescent, early diagenetic dolmicrite host rock, (ii) burial blocky saddle dolomites, (iii) dolomitic fault gouge, and (iv) late diagenetic cements likely related to Neogene transform fault activity. During latest stages of uplift and exposure, blocky phreatic and pendant vadose cements formed. A shift to ^{13}C-depleted carbon isotope values for both rock clasts and fault gouge is observed with increasing tectonic overprint. Patterns in oxygen isotope data are not in agreement with hot, transform-related fluids, but instead point to a predominantly cool source of marine fluids, hence sampling of rocks at a shallow burial position of the submerged transform fault. Preliminary results indicate a complex relation between textural and geochemical overprint. Following deposition and initial lithification, the diagenetic history of these samples commences with early dolomitization of shallow water carbonates. Evidence for early stage dolomitization comes from well-preserved sedimentary textures such as ripples and fining-upward features. During burial, the dolostones experienced a series of complex dissolution-reprecipitation steps leading to the formation of “zebra” fabrics, i.e. bedding-parallel, elongated voids filled with what are now saddle dolomites. Blocky saddle dolomite and the presence of stylolites indicate that zebra formation was caused by induced stress and precipitation from hydrothermal fluids. In addition to textural preservation, a striking absence of a pervasive geochemical overprint is observed, supporting a conservative behavior of early diagenetic dolomites. Analysis of δ^{26}Mg, δ^{13}C, δ^{18}O, and ^{87}Sr/^{86}Sr in early and late dolomite phases allows to distinguish between properties inherited by the limestone precursor and those formed during dolomitization, as well as to distinguish between pre- and syn-fault diagenetic processes and conditions.