Geophysical Research Abstracts
Vol. 20, EGU2018-1857, 2018
EGU General Assembly 2018

Towards a pragmatic definition of the burial diagenetic domain in carbonate research

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In our present understanding, the term diagenesis includes nearly all of the processes that affect a sediment after its deposition and during burial until the realm of metamorphism is reached. In contrast to clastic sediments, the diagenesis of carbonates commences at a very early stage, usually at the seafloor or at the land surface, and perhaps already during the late ontogenetic stages of some carbonate-secreting organisms. The fundamental concepts of diagenetic environments were established—mainly based on observations of recent carbonate environments—in the 1970's and 1980's of the last century. The history of terminology in diagenesis research is confusing and perhaps most of all with respect to what was referred to as catagenesis, metagenesis, telogenesis, or (deep, late) burial diagenesis and the like. According to some workers, the realm of burial diagenesis commences only a few meters to some tens of meters below the carbonate seafloor whereas research performed in the context of ocean drilling has shown that some cores still yield predominantly marine porewaters at significant burial depths. Along similar lines, threshold criteria that define the transition between deep diagenesis and metamorphosis have been discussed in the literature but none of these is universally applicable to carbonates. In contrast, research dealing with clastic sediments and particularly clay minerals (and vitrinite reflectance etc.) has provided temperature boundaries and proxies to pinpoint the deep limits of the burial diagenetic and the onset of the low-grade metamorphic domain. Along these lines, workers dealing with metamorphic petrology often define the transition zone between diagenesis and metamorphosis (anchizone between about 230 to 350oC) as the field of chlorite-illite and the onset of the low-grade metamorphic domain when clay minerals are replaced by white mica. At present, no comparable proxy exists for carbonates that allows to quantify the realm of burial diagenesis and its shallow and deep limits. Preliminary work has shown that organic matter in biominerals and abiogenic carbonates (e.g., corals, speleothems etc.) releases water when heated to temperatures of between 230 and 330oC, i.e. a temperature window that agrees with that defined for the chlorite-illite transition zone. It is here argued that the release of fluid from preserved organic matter in carbonate sediments is an important parameter triggering carbonate transformation on its way down into the metamorphic domain (marbles). I proposed that the deep limit of the carbonate burial diagenetic domain should be tentatively placed when fluid temperatures reach about 230 $\pm$ 30oC but this limit cannot be confined in terms of a specific burial depth as many different temperature/depth gradients exist in nature. The shallow limit of the carbonate burial diagenetic domain is more difficult to establish but could be placed at a depth when the pore-fluid differs significantly in terms of their composition and physico-chemical properties from the parent fluid from which the carbonate was originally precipitated in a near-surface environment.