Paragenesis of cements in the El Abra Formation, Mexico, based on clumped isotope thermometry

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Carbonate clumped isotope thermometry provides constraints on carbonate precipitation temperatures and fluid origin for applications in many low-temperature environments [1]. One area that remains relatively unexplored is the higher temperature (50–300˚C) burial diagenesis environment. Models based upon laboratory heating experiments suggest that carbonate clumped isotopes can reorder over geological timescales during burial via solid-state diffusion [2, 3]. However, few studies have investigated carbonates within deeply buried sedimentary basins with well defined time-temperature histories to calibrate these models. This study explores how burial and exhumation influences isotopic ordering of carbonate cements in the early Cretaceous El Abra Formation, east-central Mexico.

We will present a time-temperature history model of the El Abra formation with illite-age analysis and apatite fission track constraints on burial and exhumation timing. In addition, fluid inclusion microthermometry places maximum burial temperature at 165˚C. We will also present a paragenesis where we observe a 70˚C range in clumped isotope temperatures between at least three diagenetic events: an early marine radiaxial cement (~65˚C), a later meteoric coarse-equant cement (~100˚C), and a late burial cement (~135˚C). The relatively high clumped isotope temperatures associated with the marine and early meteoric fabrics exceed values we expect based on their inferred formation environments. We interpret that partial resetting occurred during burial, but did not fully reset at maximum burial temperature. We suggest that the carbonate clumped isotope geothermometer, in conjunction with laboratory-derived kinetics of isotopic re-ordering, could potentially provide new constraints on thermal histories of burial diagenesis in this ‘partial retention’ temperature range.

[1] Eiler *et al* (2007) EPSL **262**, 309-327. [2] Passey and Henkes (2012) EPSL **351-352**, 223-236. [3] Stolper and Eiler (2014) submitted. [4] Gray *et al* (2001) AAPG Memoirs 75.