Burial temperatures and $\delta^{18}O$-zoning in diagenetic cements of the Eau Claire Fm., Illinois Basin (U.S.A.)

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The WiscSIMS lab employs *in-situ* methods for measuring O-isotope compositions ($\delta^{18}O$) of zoned diagenetic cements in sedimentary strata using *Secondary Ion Mass Spectrometry (SIMS)*. Using a 10-µm beam, results are precise to within ±0.3‰ at 2SD. An important aspect of methods-advancement is the on-going development of analytical standards to correct for *instrument mass fractionation (IMF)* effects, which are often non-linear for solid-solution series minerals (*e.g.* carbonates).

Carbonate cements (calcite (Cal) → dolomite (Dol) → ankerite (Ank)) of the silty-shaley Eau Claire Fm. - which caps the underlying Mt. Simon sandstone aquifer of the Illinois Basin - are chemo-isotopically zoned, indicating growth under varying physiochemical conditions throughout the Basin's burial history. $\delta^{18}O$ systematically decreases from 28.5→16.0‰ VSMOW (**Fig. 1**) with progressive growth from a fluid – likely entrapped seawater – of nearly constant $\delta^{18}O$ (-3‰; Late Cambrian oceanic avg.) but variable temperature (~25-115°C), reflecting increasing burial and heating. This modeled temperature range is consistent with petrographic observations showing that carbonate cements first appeared in the shallow-burial environment and continued developing during deep burial and late diagenesis (≥ 2 km, T > 75°C).

Internal consistency is found with $\delta^{18}O$-zoning in quartz overgrowths (QO) surrounding detrital quartz grains (DQ) within some of the same samples. Modeling implies that QO formation first began at temperatures of ~40°C - consistent with textural relations showing that it postdates an earlier, initial carbonate cementation phase – and continued for some 200 myr, recording a step-wise temperature increase up to ~110°C with progressive burial.

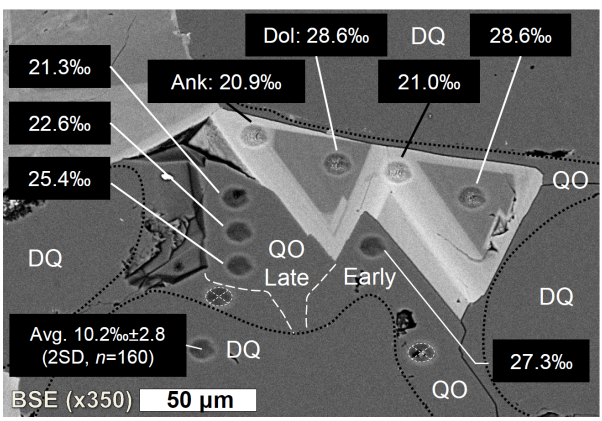

Fig. 1. $\delta^{18}O$-zoning in quartz and carbonate cements formed during progressive burial and diagenesis of the Eau Claire Fm., Illinois Basin. Note that due to pore space volume constrains, the full range of isotopic variability is not necessarily preserved in all regions analyzed