GEL 206: CARBONATE DIAGENESIS & GEOCHEMISTRY

Over the quarter, we will address the carbonate geochemical system and cover the spectrum of the carbonate diagenetic environments and the processes and carbonate products that form in these environments. We will also cover non-marine carbonate formation & diagenesis (soils, lacustrine, palustrine, speleothems, travertines), dolomitization, and evaporates of a range of origins. Readings relevant to the lectures and lab exercises will be assigned.

To complement lectures, you will work with six suites of samples and complete petrographic reports for select samples (n=5) of four suites. During some lab periods we will have discussions in order to address your questions on samples. There are no exams or term paper. Grading is based on participation in the lab periods and the petrographic reports.

Week 1 & 2 (Jan. 8 & 15): Introduction & Marine Diagenesis

Objective: Overview of class; introduction to carbonate petrology; carbonate cement textures and the environmental parameters that influence them, with a focus on recognizing marine cementation.

Lab #1:

- Suite of marine carbonate grain and porosity types, marine cements, and examples of neomorphism of marine carbonates of modern to Cambrian age.

Weeks 3 & 4 (Jan. 22 & 29): Meteoric Diagenesis

Objective: overview of petrographic evidence for subaerial exposure and meteoric diagenesis (including recrystallization/neomorphism)

Lab #2:

- meteoric processes (vadose & phreatic), porosity development, neomorphism, and cements of Pleistocene through Paleozoic age

Weeks 5 & 6 (Feb. 5 & 12) Deep Meteoric through Burial Diagenesis & Reconstructing the Evolution of a Paleo-aquifer using Carbonate Paragenesis & Geochemistry

Objective: Differentiating early vs. burial diagenetic cements and secondary porosity development; interpreting redox environments using cathodoluminescence; reconstructing a carbonate cement paragenesis and interpreting it — along with geochemical data — in the context of the evolution of an aquifer system.

Lab # 3 - Mississippian Newman Limestone suite: caliche and vadose carbonate cements, meteoric diagenetic porosity development & cementation; burial secondary dissolution and cementation. Use of carbonate chemical stains (alizarin Red and K-Fecycanide) and cathodoluminescence to infer porewater redox conditions.

For the weeks of Feb. 19—March 11 — we will spend time on the following 3 suites as suggested by interest in the group.

Weeks 7 & 8 (Feb. 19 & 26): Non-marine Carbonates

Objective: Overview of freshwater environments of carbonate cementation and diagenesis including lacustrine/palustrine, soils, speleothems, and cold and hot-water springs. Discussion of the bio-physico-chemical processes in these environments

Lab #4:

- soil-formed carbonates, modern and ancient speleothems, lacustrine/hot spring carbonates (phytoherms) and tufas; travertines

Week 9 (March 4 & 11): Dolomites

Objective: Overview of the dolomitization process and environments including neomorphic and fabric-destructive replacement dolomites and various low- to high-temperature dolomite cements. Discussion of secondary porosity development associated with dolomitization of limestones.

Lab #5

- Suite of dolomite replacement textures/fabrics, associated secondary porosity, and dolomite (Pleistocene, Cenozoic, Paleozoic) cements including marine, mixing zone, deep burial and hydrothermal dolomites.

Week 10 (March 11): Marine & Nonmarine Evaporites

Objective: Overview of marine and nonmarine evaporite deposits and their cement & replacement morphologies. Likely no lecture but lab time to look at the samples.

Lab #6:

- Suite of evaporite minerals (replacement & cements) including marine, hypersaline, and mudflat/alluvial plain environments.