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New insight into spheroidal iron (oxyhydr)oxide concretion formation models: Diagenetic concretion nucleation associated with neutral fluids from a mafic intrusion

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Directly west of the San Rafael Swell on the Colorado Plateau in the western U.S., the Jurassic Entrada Sandstone is intruded by a ~2 km long mafic dike. The dike is Miocene; however, the area is also crosscut by Laramide (~50Ma) clusters of deformation bands that are up 500 m long and up to ~3 m wide. The mafic intrusions infused the area with fluids that bleached the red sandstone directly surrounding the dike. On one side of the dike, the bleached area terminates at an adjacent deformation band set ~475 m south of the dike. Field observations suggest that the dike acted as a baffle preventing fluids from migrating further into the sandstone. Spheroidal calcite and iron (oxyhydr)oxide concretions are present in the bleached host rock, although calcite concretions (1-3 cm diameter) are present throughout the area on both sides of the deformation bands and in both red and white host rock. Iron (oxyhydr)oxide concretions (1-5 cm diameter) are limited to the uppermost bleached section between the dike and the deformation band set. Some iron concretions have solid interiors, and some have well-cemented rinds with interiors depleted of cement. Additionally, some iron concretions are nucleated on individual deformation bands that are ~2 mm wide and iron (oxyhydr)oxide cemented joint faces are also present. Thermochemical modeling shows the infiltrating Miocene fluids were CO₂-bearing, but near neutral pH. The restricted location of the iron (oxyhydr)oxide concretions and relation to the calcite concretions suggest that stagnation of fluid is needed for spheroidal iron oxyhydroxide concretion formation. Calcite concretion nucleation and growth may be quicker resulting in more widespread occurrences, and/or may have preceded the Miocene fluids that infiltrated the unit. The evidence presented here shows that recently proposed models calling for calcite concretion precursors and acidic fluids for iron (oxyhydr)oxide concretion formation may not be correct.