GEOCHEMICAL AND PETROGRAPHIC INVESTIGATION OF A NOVEL CALCITE-ARAGONITE SEA TRANSITION IN TERMINAL PROTEROZOIC TIME (549 – 548 MA)

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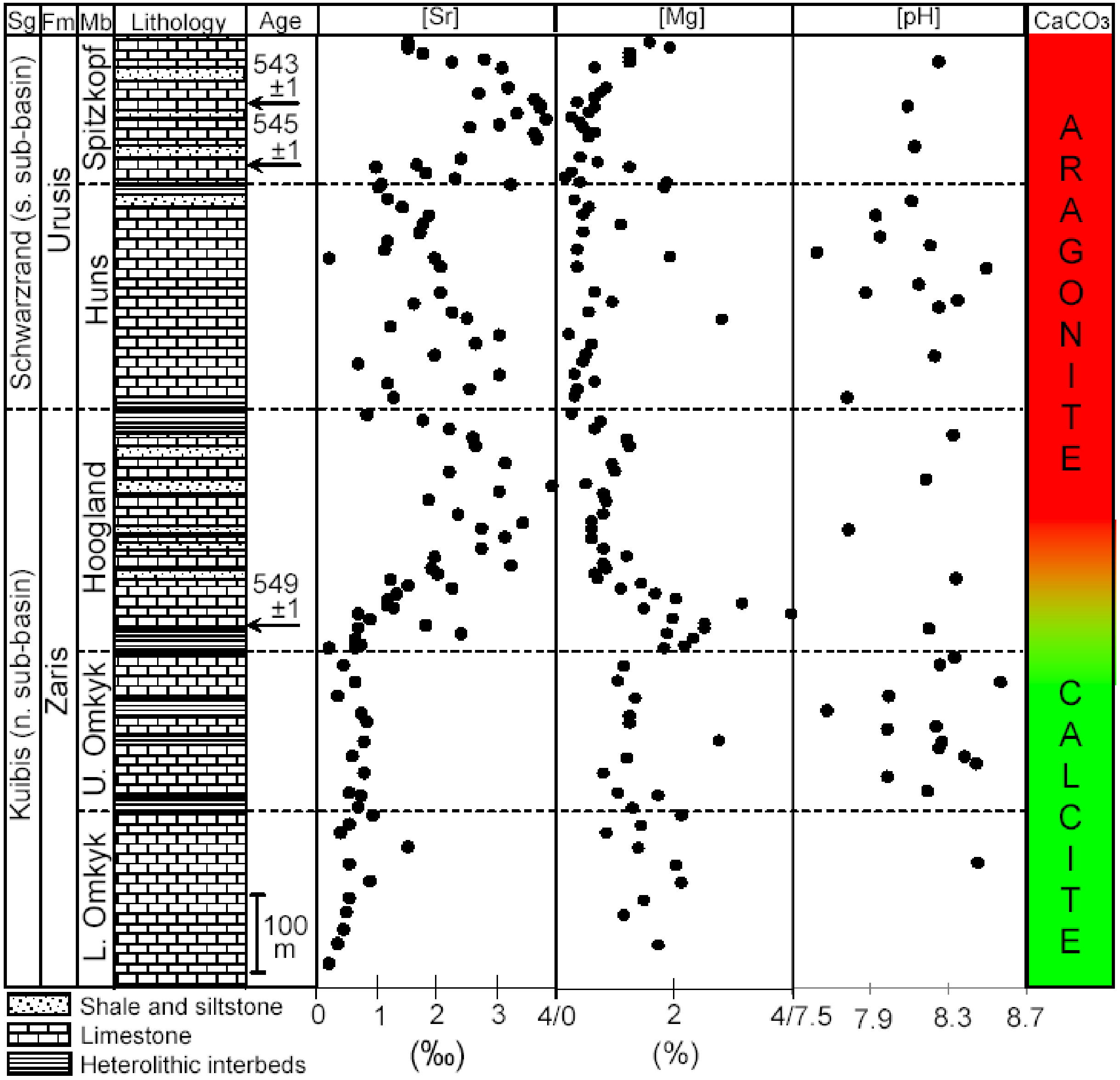

Throughout geologic time, the oceans have oscillated between intervals favoring the deposition of the aragonite polymorph of $CaCO_3$ and the calcite polymorph. The challenge to reconstructing these trends in carbonate mineralogy from the geologic record arises from the fact that the metastable aragonite converts to low-Mg calcite over relatively rapid geological timescales. PI Ries is developing a suite of geochemical and petrographic indicators of original $CaCO_3$ polymorph mineralogy to enable such reconstructions. One such indicator is the elemental composition of limestones, as elements tend to be partitioned differently in aragonite than they are in calcite. If these compositional differences survive diagenesis, then they can serve as an indicator of primary mineralogy. The figure reveals threshold changes in the Sr- and Mg-composition of marine limestones throughout a 10 m.y. sequence of terminal Proterozoic marine limestones from the Nama Group of Namibia. These threshold changes in abundance of polymorph-sensitive elements are consistent with a transition from calcite-to-aragonite seas across this critical interval of geologic time.

Also shown are relatively high frequency (~200 ky) oscillations in seawater pH reconstructed from the boron isotopic composition of the Nama Group limestones. Although these high frequency pH oscillations do not appear to have had a bearing on the calcite-aragonite transition at 549 Ma., it is of potentially substantial import that they stabilize at a relatively elevated level during the 2-3 My preceding the Cambrian Radiation—the greatest evolutionary radiation of calcified marine animals in Earth history.