2005 Salt Lake City Annual Meeting (October 16–19, 2005)

Paper No. 131-17

Presentation Time: 1:30 PM-5:30 PM

WHEN BIVALVES GET THE BLUES: VIVIANITE REPLACEMENT OF BIVALVES FROM THE KERCH IRON-ORE DEPOSITS, UKRAINE

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Replacement of original minerals during diagenesis is a form of low-temperature metasomatism that provides information on infiltrating fluids and environmental conditions during replacement. Where there are geochemical extremes, the replacement features can be extraordinary. Bivalves found in the Kerch iron-ore deposits, Crimea Peninsula, Ukraine, host exceptional blue crystals of vivianite ($Fe_3^{2+}(PO_4)_2 \bullet 8H_2O$). Bivalves range in size (1 - 5 cm) and retain only a thin coating $CaCO_3$. Vivianite forms acicular crystals up to a cm in length filling in the bivalves. The shells are set in a fine-grained matrix of brown Ca-Fe-Mn carbonates with angular to rounded clasts of quartz and feldspar up to 100 µm. XRD analyses of random and oriented samples identified carbonates, quartz and feldspar, but no clay minerals. In thin section,vivianite exhibits characteristic pale blue to blue violet to deep indigo blue pleochroism. In optical cathodoluminescence, the bivalve shell and quartz/feldspar clasts exhibited a weak luminescence, but quenching due to the presence of Fe^{2+} eliminated any luminescence from vivianite.

Based on BSE imaging, both vivianite and the bivalve shell are partially replaced by a Ca-Fe-Mn carbonate of the matrix. Parallel to the boundary, a lace-like structure of carbonates has fibers growing perpendicular to the boundary into the vivianite. There are at least two stages of mineral replacement in the shells. The original fossiliferous sediments were deposited in middle Pliocene as part of an ancient sea. The subsequent formation of vivianite suggests anoxic conditions and sediments low in sulfate, but high in iron and phosphate,with neutral to low pH and Eh. Later, conditions favorable for carbonate growth were superimposed on the vivianite. In a modern analog, the Baltic Sea, formation of Ca-Fe-Mn carbonate has been found to be a marker of anoxia and salt water inflow events. Consequently, replacement textures and mineralogy provide a method to extract conditions of diagenesis.

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