Rolling bones – Taphonomy of Jurassic dinosaur bones inferred from diagenetic microcracks and mineral infillings

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Dinosaur bones from the Upper Jurassic Shishugou Formation near Qitai in the Junggar Basin, NW China, show black manganese oxide and light quartz infillings in the bone pore space such as Haversian canals and diagenetic cracks. The manganese oxides are identified by X-ray diffraction as pyrolusite. Some Haversian canals are only partially filled with pyrolusite, which forms miniature geologic spirit levels. The orientations of these spirit levels have been measured and several generations of pyrolusite infillings determined, indicating that the bones were turned around once or several times during their fossilization. Characteristic desiccation cracks in the dinosaur bones indicate deposition on the soil surface and early diagenesis under dry climate conditions in the Upper Jurassic in NW China. During dry season evaporation and resulting capillary forces drove the groundwater with dissolved manganese-(II)-ions towards the soil surface and further into the capillary system of the bones. Hence the capillary system of the bones was already in contact with that of the sediment when the bones were still lying on the surface and were not yet totally embedded in the sediment. Mn(OH)$_2$ precipitated under high pH conditions in the pore space of the bones such as Haversian canals and cracks. During late diagenesis, the Mn(OH)$_2$ was oxidized to MnO$_2$ and transformed into pyrolusite. Mineral infillings and desiccation cracks in fossil bones thus can yield valuable insights into the taphonomic history of skeletal remains such as environmental conditions during diagenesis and fossil reworking.

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