# A Triassic-Jurassic Mass Extinction Boundary Sequence

David A. Kring and David H. Goodwin

The Triassic-Jurassic mass extinction event 200 million years ago is one of five major mass extinction events generally recognized to have occurred in the Phanerozoic (i.e., after complex life evolved on Earth). This event extinguished the same number of species (76 ± 5%) and genera (47%) as the Cretaceous-Tertiary mass extinction event (Jablonski, 1991), which has been linked the Chicxulub impact event (e.g, Hildebrand et al., 1991). Because statistical analyses of impact cratering events suggests there should have been approximately five Chicxulub-size events during the last 540 Ma, it has been hypothesized that all of the major mass extinction events, including the Triassic-Jurassic event, were caused by impact cratering processes. We have been examining a sequence of rocks deposited across the Triassic-Jurassic boundary in the Queen Charlotte Islands of British Columbia to determine if this hypothesis is true or whether there are other causes of the mass extinction. An initial interpretation of this sequence (Ward et al., 2001) suggests the mass extinction occurred within an interval of 50,000 yrs and that biological productivity collapsed for 500,000 yrs, although the cause for the extinction and productivity collapse was unclear.

The boundary sequence at Kennecott Point in the Queen Charlotte Islands is composed of a series of carbonaceous shales, siltstones, and sandstones. The coarser units are often cross-stratified and graded, suggesting deposition in high energy environments. Bioturbation is also common in these units. Thin horizons of volcanic ash are interspersed through the sequence. Desrochers and Orchard (1991) suggested this was a turbidite sequence deposit far offshore in a deep basin, although we suggest the sequence was deposited in a relatively near-shore and shallower basin.

The black shales are dominated by clay and quartz, with additional silicates and organics. The black shales suggest the water at the bottom of the sedimentary basin was often anoxic, which is confirmed by abundant sulfide framboids in the shales and other units in the sequence. Lighter-colored siltstones within the shale sequence are composed of quartz, feldspar, and minor mafic minerals (now altered largely to phyllosilicates). Some of the lighter colored units also appear to be altered volcanic ashes, with large phenocrysts of twinned plagioclase and minor mafic minerals (also altered to phyllosilicates). Spherules are abundant throughout the section, but those studied thus far appear to be abraded sedimentary particles, abraded volcanic particles, and secondary alteration products, rather than impact melt spherules.

The precise location of the boundary is still uncertain. Upper Triassic ammonites and radiolarians were reported approximately 17 and 7 meters, respectively, below the appearance of Jurassic radiolarians (Ward et al., 2001). However, we found several folds and faults in the section that make these values unreliable. We have now found upper Triassic ammonites within 5 meters of where the Jurassic radiolarians were reported. Both of these collections were made on the same side of the faults and folds, so this likely defines a true boundary interval.

The sedimentary layers in this sequence vary from microscopic laminae to beds a few centimeters thick. On an outcrop scale, there are no obvious impact ejecta units. Micro-scopically, however, there are hundreds of layers to be examined.