**A LITHOLOGICAL INVESTIGATION OF MARINE STRATA FROM THE TRIASSIC-JURASSIC BOUNDARY INTERVAL, QUEEN CHARLOTTE ISLANDS, BRITISH COLUMBIA, INCLUDING A SEARCH FOR SHOCKED QUARTZ.** A. Patzer[1], D. A. Kring[1], D. H. Goodwin[2], P. D. Ward[3] and J. W. Haggart[4]. [1] Lunar and Planetary Laboratory, University of Arizona, Tucson, AZ 85721 (apatzer@lpl.arizona.edu), [2] Department of Geology and Geography, Denison University, [3] Department of Biology/Astrobiology Program, University of Washington, [4] Geological Survey of Canada, Vancouver.

**Introduction:** We examined 42 thin sections of marine sedimentary rocks retrieved from Kennecott Point on Graham Island of the Queen Charlotte Islands (British Columbia, Canada). Kennecott Point harbors one of the best preserved and least disrupted stratigraphic sequences spanning the Triassic-Jurassic (T-J) boundary [1]. The samples comprise thinly-bedded, alternating limy shales, silts, and mudstones with intermittent bands of greywacke, lithic arenite, and volcaniclastic micro-conglomerate. The strata are assigned to the Sandilands Formation (uppermost Norian, Hettangian, and Sinemurian) of the Kunga Group [2]. They are believed to be silicified and, with respect to the shale, organic-rich [3]. The sequence has been variously interpreted to represent a deep basin setting that includes turbidite deposits [3] and as a shallow-marine, potentially shelf, environment [1].

**Incentive and Results:** The T-J transition is marked by one of the five largest mass extinctions known in Earth's history [e.g., 4], yet, its trigger is not well established. Current debates on this topic have suggested several possible causes including a major impact event. We examined the thin sections of the T-J boundary samples from Kennecott Point for shocked quartz, spinel, or any other mineralogical indicator in order to test the impact hypothesis.

At Kennecott Point, the T-J transition is constrained by radiolarian and ammonoid biostratigraphy to an interval approximately 5.5 m in thickness [5, 1]. Recent reports on the carbon isotope inventory of these strata demonstrate a pronounced productivity collapse [6, 7] that coincides closely with the sudden extinction of marine fauna in the section. We focused our sedimentological study on this ~5 m thick interval.

The suite of thin sections discontinuously covers approximately 1 m of the sampled sequence and was prepared from those rocks that appeared most likely to bear impact ejecta. Many thin sections display vivid stratification (Fig. 1). We counted over 230 sub-mm to cm-sized individual bands. Each layer was examined to determine if it represented an impact ejecta horizon or a sedimentary deposit that contained ejecta eroded from adjacent highlands.

With regard to the primary objective, our survey reveals that both detrital and authigenic quartz is relatively rare. Spinel was not detected. Most mudstone and greywacke beds are dominated by feldspar detritus. The volcaniclastic micro-conglomerates in the upper and middle part of the sampled sequence are chiefly composed of large, euhedral feldspars and rounded igneous clasts. All feldspars have pure albite or, occasionally, orthoclase compositions. Calcite overgrowth of feldspar grains, small calcite concretions (sub-mm sized pods), and partially micritic matrices count among the common features of most thin sections. Chlorite is a typical matrix component of the shales and volcaniclastic micro-conglomerates. Pyrite is ubiquitous, but occurs in low abundances. Sand-sized detrital quartz, when present, includes mostly monocrystalline grains with sharp or undulose extinction, rare polycrystalline grains, and rare striated grains. Shock features were not identified. Interestingly, though, we found that the entire rock suite was not silicified but thoroughly albitized. Veins crosscutting many samples are either filled with fine-crystalline albite or calcite.


Fig. 1. Specimen QCI7601-17.1B showing mm-sized lamination typical of many samples.

By quantifying the proportions of detrital components like feldspar, quartz and lithic clasts, one can determine the provenance (source terrane) of the sediments [see 8]. Point counts of selected horizons and thin sections suggest that the volcaniclastic micro-conglomerates are consistent with debris from an undissected magmatic arc (Fig. 2). This result is supported by the clast lithologies, which are dominated by andesites and rhyolites. Unfortunately, albitization makes it difficult to identify the provenance of the abundant siltstones among the Kennecott Point sediments.

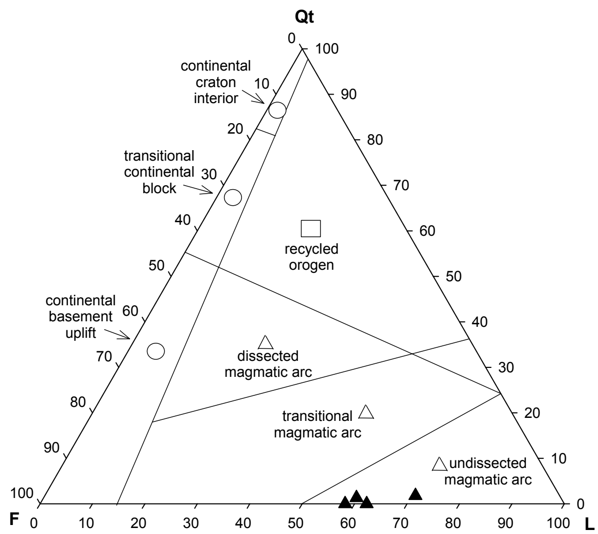


Fig. 2. Provenance diagram after Dickinson [8]. The four samples projected here are volcaniclastic micro-conglomerates that are apparently derived from an undissected magmatic arc (F = total feldspar grains, L = volcanic + sedimentary lithic fragments, Qt = total quartzose grains).

**Discussion:** Albitization is a widespread phenomenon reported for many types of sediments and localities [e.g., 9, 10]. Minimum temperatures required for this diagenetic process are as low as ~65° C [9]. According to the definitions of [9], authigenic albite in our sample suite can be classified as Type II and III. Type II albite is characterized by its blocky appearance with grain sizes of 5 to 90 μm and lack of dissolution porosity. Required temperatures of the Type II regime are >90° C. Type III refers to authigenic albite overgrowths of detrital feldspars.

The temperature constraint inferred from authigenic albite is in accordance with conodont data from sediments at Kennecott Point, which yield a temperature range of ~50 to 140° C [11].

We also detected authigenic chlorite at various levels of the sampled sequence suggesting at least late diagenetic or mesodiagenetic conditions (i.e., ~70° to >100° C depending on depth [e.g., 12]).

The widespread occurrence of microcrystalline, framboidal pyrite indicates euxinic bottom conditions, consistent with a scarcity of benthic fauna [1, 2, 6]. The mostly microcrystalline form of the pyrite further suggests a rather near-shore depositional setting; in a remote basinal location, one would expect larger, discrete euhedral pyrite indicating slow supply rates of dissolved Fe and/or S [12].

**Conclusions:** Our investigation of a suite of marine strata from the Sandilands Formation (T-J boundary) yields evidence for a thorough albitization event that affected at least the Kennecott Point area of the Queen Charlotte Islands in British Columbia (Canada). The albitization generally limits the prospects of our ongoing provenance study but does not influence the fact that the volcaniclastic micro-conglomerates are derived from an undissected andesitic and rhyolitic magmatic arc.

As opposed to the common opinion advocating a deep basin setting, we further conclude that lithological attributes favor a relatively near-shore deposition of the analyzed rocks [see also 1]. Finally, we found no evidence (e.g., shocked quartz) that supports an impact-related end-Triassic extinction. We want to caution, however, that the lack of impact ejecta does not prove an impact did not take place. It is also possible that any impact debris produced at the T-J boundary was not deposited in the basin represented by Kennecott Point, or at least the part of the basin represented by our thin sections. We are currently pursuing analyses of mineral residua from the entire sequence of boundary sediments to minimize this uncertainty. Nonetheless, at the present time, it seems prudent to examine other boundary localities and/or test other hypotheses for the extinctions detected in the T-J boundary interval.

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