BEFORE THE SUBDUCTION: Clay Mineralogy & K/Ar Geochronology of Pacific Plate Sediment Entering the Japan Trench

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The 2011 Tohoku earthquake produced a catastrophic tsunami along the Japanese coast, highlighting the need for a better understanding of earthquake hazards along this subduction zone margin. We combine biomarker evidence of earthquake heating with K-Ar ages of associated clay minerals to interrogate the pre-historic frequency of large earthquakes in the Japan Trench. An important aspect of this work is characterizing the composition of sediment inputs to the subduction zone. This study is motivated by the need to establish a mineralogical and geochronological background for the study of sediments of the incoming Pacific Plate recovered during the 2024 JTRACK expedition.

We selected sixteen sediment samples from Core C0026B with a focus on those that could be correlated with claystone, pelagic clay, and chert units in the plate boundary fault zone (Site C0019). We used X-ray diffraction (XRD) to characterize the mineralogy of bulk samples and then performed size separations to isolate and further subdivide the clay fractions. XRD results indicate presence of illite, smectite, quartz, carbonates, oxides/hydroxides and other silicate phases. Smectite was frequently identified as a mixed-layer illite-smectite (I/S). Preliminary analyses indicate that the fine fractions (< 0.2 μm in equivalent spherical diameter) have radiogenic 40Ar concentrations that are consistently lower than the bulk samples, suggesting younger ages. Complete K-Ar dating of these clay separates is underway.

These data provide a mineralogical and geochronological reference frame for incoming Pacific Plate sediments that will be valuable for future investigations of Japan Trench samples and that have implications for subduction margins in general.

Collectively this work will contribute to our understanding of subduction processes and seismic hazard in regions that are vulnerable to large but infrequent megathrust earthquakes.