Origin of frictional melt in the Jurassic accretionary complex of the Mino Belt on the basis of trace element and isotope analysis

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Pseudotachylytes (solidified frictional melts) in exhumed accretionary complexes have great significance for understanding the dynamics of earthquake faulting in subduction zones. However, they are rarely preserved in a recognizable form mainly due to subsequent hydrothermal alteration. Recently, a pseudotachylyte was found in the Jurassic accretionary complex of the Mino Belt, central Japan. The pseudotachylyte is ~2 mm-thick and separates gray chert above from cataclasite below. Although the pseudotachylyte has been hydrothermally altered, its microstructures are characterized by presence of fault and injection veins, intensely cracked gray chert fragments incorporated from wall rocks, and locally embayed and rounded wall rocks, suggesting thermal cracking and thermal erosion associated with increased heating. Here, we analyzed major and trace elements and Sr and Pb isotopes of the milligram-level samples taken by micro-milling technique along the structures of the pseudotachylyte, cataclasite and gray chert, as well as the black chert and black carbonaceous mudstone near the pseudotachylyte. The pseudochylyte exhibits remarkably high trace element concentrations compared to those of gray chert. The trace element composition of the pseudotachylyte requires the involvement of black carbonaceous mudstone as well as gray chert, suggesting that the frictional melt originated from the mixture of gray chert and black carbonaceous mudstone. Based on major and trace element chemistry, the mixing ratio is estimated to be ~50–60% of gray chert and ~40–50% of black carbonaceous mudstone, and the ratio is consistent with the Sr and Pb isotope compositions. Despite the hydrothermally alteration, the chemistry of the pseudotachylyte well preserves melt-derived characteristics, thus provides useful information for understanding the frictional melting on faults and its source materials.

Keywords: pseudotachylyte, frictional melting, trace element analysis

