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Shocked melt veins as recorders of paleomagnetic field for an asteroidal parent-body

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Dynamic shock remagnetization alters remanence vectors in meteorites, so that it makes extraterrestrial paleomagnetism complicated. Heavily shocked meteorites of shock stages S5 and S6 often contain a shock-induced melt veins (SMVs), which might have reset the remanence of an asteroidal thermal metamorphism at the time of hypervelocity collisions against a chondrite parent-body. We present micropaleomagnetic and petrologic studies of SMVs in L6S5 Tenham chondrite with a dense network of c.a. 1mm thick black veins enclosing high-pressure minerals such as ringwoodite and majorite embedded in silicate glass formed under high pressure and high temperature dynamic shock conditions, by SQUID magnetometer. Paleomagnetic data of 2mm cubes of SMV show a 50% higher mean destructive field of remanence than the surrounding matrix in alternating field demagnetization experiments. Stepwise thermal demagnetization tests show that the remanence orientations in SMVs possess two different orientations of low and high temperature components. The high temperature components of SMVs formed a cluster even from different portions of SMV, whereas the remanence in surrounding matrix showed a scattered orientation under stereonet projection. Magnetic force microscopy and backscattered electron images confirmed the remanence-carrying mineral in SMVs as a fine-grained low-Nickel FeNi (kamacite). Blocking diagram for low- Nickel kamacite and thermal demagnetization results suggested that the low component of SMV is due to a secondary terrestrial remagnetization and the high component (unblocking temperature = 270-600C) is a characteristic shock-induced thermal remanence that has newly been acquired during hypervelocity collision with a parent-body. Therefore, the SMV's newly acquired remanence could have preserved an ancient magnetic field over an asteroidal parent-body at the time of hypervelocity collisions, providing a post-metamorphic solar magnetic field or an intrinsic parent-body magnetic field.