# SHOCK METAMORPHISM OF THE NEW FALL ORDINARY CHONDRITE MANGUI IN CHINA

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**Introduction:** The Mangui meteorite is the newest meteorite fall in Yunnan, China on June 1, 2018. More than 500 fragments have been collected in a total mass of ~50 kg along the projectile area of about 20 $km^2$ [1]. Mangui is classified as a L6 chondrite and its shock stage is S5 [1]. Here we report the progress on the high-pressure polymorphs from Mangui to constrain the P-T-t history of the shock processes for the parent body.

**Experimental Methods:** Four polished sections were studied in this work. The petrography was observed by Zeiss-Supra55 SEM at the National Astronomical Observatories of the Chinese Academy of Sciences (NAOC). The mineral chemistry was determined by JEOL JXA-8230 EPMA at NAOC and the Institute of Geology and Geophysics, Chinese Academy of Sciences (IGGCAS). Raman spectra was acquired by Renishaw inVia-Reflex Micro-Raman Spectrometer at the Technical Institute of Physics and Chemistry, Chinese Academy of Sciences. The X-ray diffraction data was obtained by using the X-ray diffractometer (XRD, SmartLab, RIGAKU) at the National Institute of Polar Research. The preparation of TEM samples by Zeiss Auriga Compact focused ion beam (FIB) system at IGGCAS. The structural characterization of minerals was analyzed by JEM-ARM200F TEM at the Institute of Physics Chinese Academy of Sciences.

**Results and Discussions:** Mangui has a black fusion crust and was highly shocked as the presence of shock melt veins and pockets in the specimen. Mangui is mainly composed of olivine, pyroxene, plagioclase, Fe-Ni metal and troilite, with minor phosphates and chromite. The chemical compositions of olivine ($Fa_{25.1\pm0.3}$, n=71), low-Ca pyroxene ($Fs_{21.1\pm0.3}Wo_{1.5\pm0.2}$, n=58) and plagioclase ($Ab_{84.1\pm0.7}Or_{7.3\pm0.4}$, n=49) are homogeneous in the host rock [1]. The peak of olivine 130 gives 2 theta = 32.1116º and the FWHM = 0.1639 by the measurement of XRD.

Two high pressure polymorphs, jadeite and majorite, have been found in the shock melt veins (SMV) and pockets. Jadeite is the major high-pressure polymorph in the SMV and pockets with granular morphology similar to the texture of Chelyabinsk [2], coexisting with maskelynite. Jadeite varies from 2 to 20 μm in grain sizes, and has strong Raman peaks at 698 and 1035 $cm^{-1}$ as well as some minor peaks at 205, 376 and 990 $cm^{-1}$. The analysis of TEM shows that the subhedral jadeite grains coexisted with maskelynite with hundreds of nanometre. In one location, needle-shaped grains, probably stishovite or silica glass, were found in maskelynite that is coexisting with jadeite. The needle-shaped silica phases have similar texture to stishovite observed in some martian meteorites [3-4], indicating that they recrystallized from melt rather than dissociated from plagioclase. However, we did not detect any Raman peaks of coesite, stishovite, and higher pressure silica polymorph from these needle-shaped grains, suggesting that early formed high-pressure silica polymorphs might have been inverted to glass during decompression.

Majorite coexisted with a jadeite assemblage, occurring as inclusions enclosed by jadeite and an overgrowth layer of the jadeite assemblage. Micrometer-sized polycrystals of majorite enclosed by jadeite has subhedral textures and mainly located around the border of the inclusion in where the central area is componented of olivine, pyroxene, and Fe-Ni metal. The layered mjaorite has similar textures to that enclosed by jadeite. Both types of occurrences of majorite have a strong Raman peak at 930 $cm^{-1}$. Moreover, micrometer-sized recrystallized pyroxene in the matrix surrounding to the jadeite assemblage has typical Raman peaks of pyroxene as well as a minor peak at ~930 $cm^{-1}$, indicating the presence of majorite. The morphology and textures of majortie are consistent with the scenario that majorite crystallized from the melt instead of solid-solid transformation.

The presence of jadeite and majorite in Mangui indicate that the parent body experienced strong shock metamorphism in good consistent with the XRD measurement [6]. The shock pressure and temperature should be 17–20 GPa and 1900-2000 °C respectively in terms of the coexistence of jadeite and majorite [2,5]. However, no ringwoodite and other high-pressure polymorphs were detected in the SMV, probably indicating that they were converted to room pressure phase during decompression or did not formed in the shock processes.

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**References:** [1] J. L. Ji. et al. (2019) *Chinese Science Bulletin* 64:579–587. [2] Ozawa S. et al. (2014) *Scientific Reports* 4: 5033. [3] Chennaoui Aoudjehane H. et al. (2005) *Meteoritics & Planetary Science* 40:967–979. [4] El Goresy A. et al. (2013) *Geochimica et Cosmochimica Acta* 101:233-262. [5] Tomioka N. et al. (2016) *Advanced Science* 2: 1–5. [6] Imae N. et al. (2019) *Meteoritics & Planetary Science* 54:919–937.