DISCOVERY OF ALBITIC JADEITE IN THE HISTORICAL MOCS ORDINARY CHONDRITE.

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Introduction: The Mocs meteorite fell in Romania on February 3rd, 1882. Following the appearance of a bright meteor and detonations, a shower of stones fell over a ~14.5 km by 3 km elliptical strewn field. About 3,000 stones were recovered (~1,600 of which are in the Natural History Museum Vienna (NHMW) collection), with the overall weight estimated at ~300 kg, and the largest individual stone weighing roughly 56 kg [1]. The meteorite is classified as an L5-6 ordinary chondrite with a degree of shock from weakly shocked S3 to strongly shocked S5 [2]. To date, no high-pressure (HP) phases have been reported for this historical meteorite. The main goal of this study is to evaluate – by applying a range of complementary techniques – the level of shock metamorphism recorded by the shock veins.

Materials and Analytical Methods: One polished thin section of Mocs (NHMW-L3417) was investigated using a variety of techniques, including optical microscopy (both transmitted and reflected light), electron probe microanalysis (EPMA; back-scattered electron imaging, energy-dispersive X-ray spectrometry and wavelength-dispersive X-ray spectrometry), and Raman spectroscopy (514 nm laser).

Results and Discussion: We report the discovery of albitic jadeite (jd) in Mocs, in the form of dendritic crystals within a Na-rich melt pocket inside a shock vein. The empirical formula by EPMA is $Na_{0.40\text{-}0.63}Ca_{0.07\text{-}0.08}K_{0.03\text{-}0.4}\square_{0.25\text{-}0.49})(Al_{0.82\text{-}0.86}Si_{0.14\text{-}0.20}Fe_{0.01\text{-}0.04})Si_2O_6$, with Ca# [100×Ca/(Ca+Na)] 11.3-15.5 (Fig. 1A); with >0.10 vacancies and >2.1 Si atoms per formula unit, this clinopyroxene solid solution is albitic jadeite. The most reliable analyses show ~25% M2 site vacancy and excess Si ~20% on M1 [3,4]. The apparent M2 vacancies range up to 49%, but vacancy values above ~26% suggest sodium loss due to beam damage and are probably not reliable (Fig. 1A). The Raman spectrum of the albitic jadeite displays the typical peaks at ~702, 378, and 1034 cm^{-1}, in agreement with reference jadeite (RRUFF database for jd: #R050220; Fig. 1B).

Conclusion: The Mocs meteorite is weakly to moderately shocked. The formation of an HP phase, albitic jadeite, requires an unknown minimum shock pressure and its recovery without back transformation indicates an unknown maximum post-shock temperature. The high Ca# and high concentration of vacancies in a few of the analyzed points indicates either the presence of minor Ca-Eskola end-member or beam-sensitivity (and Na-loss). The various albitic jadeite occurrences observed to date display a range of beam-sensitivity; this instance is likely one of the more beam-sensitive.

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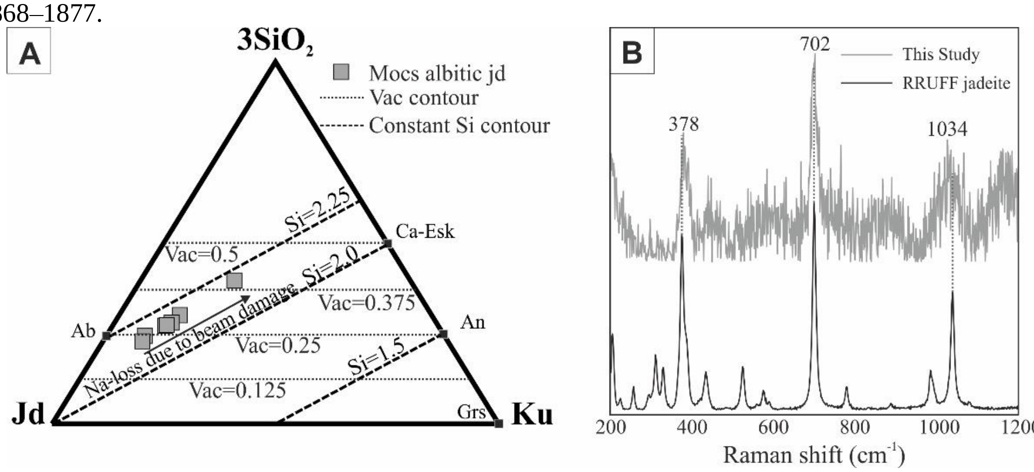

Figure 1. (A) $3SiO_2$-Jd-kushiroite (Ku) diagram showing the albitic jadeite analyses from Mocs. The black arrow indicates sodium loss due to beam damage. (B) Raman spectrum from Mocs jadeite (grey line) compared to reference jadeite from the RRUFF database (black line; #R050220).