CHONDRULES IN CLUSTER CHONDRITES: DEFORMATION FEATURES AND OXYGEN ISOTOPES.

K. Metzler[1], A. Pack[2], F. Langenhorst[3], and D. Hezel[4].
[1]Institut für Planetologie, Universität Münster, Germany. E-mail: knut.metzler@uni-muenster.de. [2]Geowissenschaftliches Zentrum, Universität Göttingen, Germany. [3]Institut für Geowissenschaften, Universität Jena, Germany. [4]Institut für Geologie und Mineralogie, Universität Köln, Germany.

Introduction: Cluster chondrites (clch´s) are characterized by close-fit textures of deformed and interlocked chondrules. They show the highest chondrule abundances compared to all chondrite classes (82-92 vol%) and contain only small amounts of interchondrule matrix (3-9 vol%). They occur as lithic clasts in UOC´s with sizes between 1 mm and 10 cm [1, 2].

Chondrule deformation features: The degree of chondrule deformation is defined as the percentaged perimeter increase of a chondrule cut face compared to the perimeter of an equally sized circle. The maximum deformation found among 447 chondrules investigated by this way is 56%. The mean degree of chondrule deformation in clch clast varies between 11% and 18%, compared to 5% for chondrules in the clastic matrices. All chondrule textural types occur in deformed and undeformed shapes. RP chondrules tend to be less deformed (11% mean) than the other chondrule types (13-18% mean) [2]. A strongly deformed cryptocrystalline chondrule in NWA 1756 (LL3.10) was investigated by TEM. No indications for solid state deformations were found, but the texture indicates crystallization of groundmass olivines during or after viscous deformation of the chondrule. In order to investigate the 3D textures of clch´s we performed a micro-CT scan on a centimeter-sized sample of a clch clast from NWA 5205 (LL3.7). Due to the different Fe contents of chondrules and the presence of Fe-rich interchondrule material the intergrowths of deformed chondrules are clearly visualized.

Oxygen isotopes: Bulk oxygen isotopic compositions of 4 clch clasts from NWA 5205 and NWA 5421 (LL3.7) were measured by IR-laser fluorination/mass spectrometry. The data points extend the trend for bulk unequilibrated H-L-LL chondrites in the three-isotope diagram towards ^{16}O-poor compositions (δ'^{17}O: 4.5-4.6 ‰; δ'^{18}O: 6.6-7.0 ‰;). Additionally, the bulk oxygen isotopic compositions of 66 chondrules from 4 clch clasts in 3 UOC´s (Krymka: LL3.2, NWA 5205, NWA 5421) were measured in-situ by UV-laser ablation fluorination/mass spectrometry. Chondrules in all clch clasts scatter along lines with similar slopes in the three isotope diagram (Krymka: slopes 0.70, 0.71; NWA 5205: 0.70; NWA 5421: 0.68). We interpret these lines as mixing lines resulting from exchange between chondrule melts and an isotopically heavier oxygen reservoir in the solar nebula.

Conclusions: Shortly after their local formation and oxygen exchange with the surrounding gas, chondrules from clch´s deformed in a hot stage, possibly due to collisional compression by continuously accreting hot material. Chondrule collisions could have occurred during formation of chondrule clusters, of small planetesimals or when they reached the surfaces of already existing bodies. A high density of hot particles during this process is documented by high P_{Na} in the surrounding gas, deduced from high Na concentrations in Semarkona type II chondrules [3].

References: [1] Metzler K. 2011. *LPI Contribution No. 1639*:9111. [2] Metzler K. 2012. *Meteoritics and Planetary Science* 47:submitted. [3] Hewins R.H. et al. 2012. *Geochimica et Cosmochimica Acta* 78:1-17.