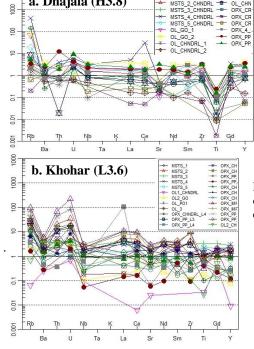
IN-SITU TRACE ELEMENTS & REE GEOCHEMISTRY OF CHONDRITES (H & L): INSIGHTS INTO COSMOCHEMICAL PROCESSES.

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Introduction: Two unequilibrated ordinary chondrites e.g. Dhajala (H3.8) and Khohar (L3.6) have been analyzed by LA-ICPMS (Quadrapole) to decipher in-situ trace elements (TEs) and REEs distribution among different types of chondrules/clasts and mesostasis (composed of feldspathic glass \pm Cpx). Selective fractionations of TEs and REEs among these H and L-type of chondrites may involve stellar cosmo chemical process(es). The partitioning of different trace elements and REEs among the various silicate phases, in particular olivine, enstatite chondrules and mesostasis, is very sensitive to its nebular formation conditions [1, 2].

Analytical Setup: Trace elements were analysed using the 213 nm, Teledyne Cetac Technologies, LSX G2 laser ablation unit installed at GSI, Faridabad and coupled with a Agilent Technologies 7700x mass spectrometer. The ICP-MS was operated at 1350 W plasma power. Ablations were performed in pure He-atmosphere (550ml min⁻¹) mixed before entering the Plasma torch with a flow of Ar (830 ml min⁻¹). Laser ablation conditions are: Laser power ~ 55% (2.5mJ) with pulse frequencies varying between 5 and 10 Hz and spot sizes of 50 - 30 μm, carrier gas flow (He + Ar) is 1.38 L min⁻¹ in ICP unit. With such pulse frequencies, depth speed for silicates analysis is about 1 µm s⁻¹. Each analysis consists of 60 s of background analyses and 30 s of ablation or sample run time. Data reduction was carried out using the GeoPro software. Calibration for the analysis was carried out using NIST 612 and NIST 614 glasses as external standards [3].

Results and Interpretation: Detailed petrography, mineral phase chemistry, and P-T calibrations of solidstate thermal metamorphism have been attempted so far (Table-1). In-situ laser ablation was performed on olivine and enstatite chondrules (e.g. BO, PO, GO, POP, PP and GP) and mesostases. Our studies help to constrain trace elements and REEs budget among different genetic types of chondrites (H and L) highlighting elemental fractionation involving cosmo chemical process(es). Being of varied chemical and petrologic types, these two ordinary chondrites show microdomains of chemical and textural inhomogenity ($^{Ol}X_{Mg} = 0.73 - 0.86$ and 0.68 - 1.00 varied in Dhajala and Khohar respectively), thermally equilibrated at $\sim 850^{\circ}$ C ($\pm 50^{\circ}$), and having comparable HREE and LREE distribution pattern. Both the chondrites show characteristic (+ve) anomaly observed in U, Zr and strong (-ve) anomaly in Sr, Ti and Th, except for Khohar in which Th shows (+ve) anomaly (Figure 1a & b). Fractionation of these selective elements in various textural phases can be correlated either to their inherent chemical heterogeneity or other cosmochemical exogenic process (es) like solid to melt fractional crystallization due to collisions and/or cosmic nebular condensation.



a. Dhajala (H3.8)

Table 1: Comparative data table of Dhajala (H3.8) and Khohar			
(L3.6) chondrites			
Meteorite	Chondrule	Mineral Phase	Equilibration
Name &	Texture /	Chemistry	Temperatures in
Type	Type		°C
Dhajala	BO, POP, PP,	$^{Ol}X_{Mg} = 0.73 -$	850 (± 52)
(H3.8)	PO, GO	0.86 and OpxX _{Mg}	
		= 0.608 to 0.890 .	
Khohar	POP, BO, PO,	$^{Ol}X_{Mg} = 0.68 -$	$780 - 880 (\pm 50)$
(L3.6)	PP, GP	0.88 & 0.92-1.00.	
		$^{Opx}X_{Mg} = 0.70 \text{ to}$	
		0.86 and 0.91-	
		0.98.	

Figure 1a & b: Chondrite normalised REEs and trace elements spidergram [4] of Dhajala (H3.8) and Khohar (L3.6) chondrites obtained from olivine & Opx chondrules / clasts and mesostasis, analyzed by LA-ICPMS (Quadrapole).

References: [1] Jacquet E. et al. (2012) Meteoritics & Planetary Science 47:1695-1714. [2] Jacquet E. et al. (2015) Geochimica et Cosmochimica Acta 155:47-67. [3] Pearce N. J. G. et al. (1997) Geostandard News Letters 21: 115-144. [4] Sun S. S. (1982) Cosmochim. Acta, 46: 179-192.