EXPERIMENTAL PETROLOGY OF A LUNAR BULK COMPOSITION CONSTRAINED BY PHYSICAL DATA. E. J. Tronche[1] and W. van Westrenen[1], [1] VU University Amsterdam, De Boelelaan 1085, 1081 HV Amsterdam, The Netherlands (elodie.tronche@falw.vu.nl).

Introduction: During the 40 years following the Apollo sample return missions, several lunar bulk compositions have been proposed [1]. Their Al_2O_3 contents vary between 3.7 to 7.5wt%, and their FeO contents range from 7.7 to 13.6wt%. Recently, Khan and coworkers [2,3] inverted lunar seismic and gravity data for composition and temperature using a thermodynamic database for the system FeO-CaO-MgO-Al_2O_3-SiO_2 (FCMAS). The resulting bulk lunar composition has a relatively low Al_2O_3 content (4.3wt%) and high FeO content (12.5 wt%). This composition satisfies the sismic and gravity data of the Moon, which is not the case for other proposed compositions with higher Al_2O_3 content, like the Taylor Whole Moon (TWM) composition [4]. The Khan et al. preferred composition is also different from a Lunar Primitive Upper Mantle (LPUM) model derived from a terrestrial upper mantle [5], especially with regards to its Mg#.

Small differences in bulk chemistry can have a major impact on the crystallization sequence of a lunar magma ocean. We aim to constrain the crystallization sequence, mineral compositions, and trace element behaviour in a lunar magma ocean with a starting composition based on the FCMAS composition proposed by Khan et al. [2]. Since ilmenite is a crucial mineral in magma ocean crystallization and subsequent overturn (e.g. [6]) due to its high density, we add TiO_2 as a component in our starting composition..

Experimental methods: The starting composition is shown in Table 1. The composition is based on [2], with addition of TiO_2 in chondritic abundance.

	SiO_2	TiO_2	Al_2O_3	MgO	FeO	CaO
This study	45.35	0.4	4.3	34.35	12.45	3.15
TWM	44.4	0.31	6.14	32.7	10.9	4.6
LPUM	46.1	0.17	3.93	38.3	7.62	3.18

Table 1: Starting composition used for this study. TWM and LPUM compositions are indicated for comparison.

Experiments were performed both at room pressure in a high temperature furnace and with an end-loaded piston-cylinder at VU University Amsterdam. Pressures of 0, 1, 1.5, 2, 2.5 and 3 GPa and temperatures between 1600°C and 1000°C were applied during 10 to 104h. Experimental charges were then polished and analysed with the JEOL 8600 electron microprobe at VU University Amsterdam. Mineral-melt trace element partitioning studies are planned at a later stage using the phase equilibrium work as a basis.

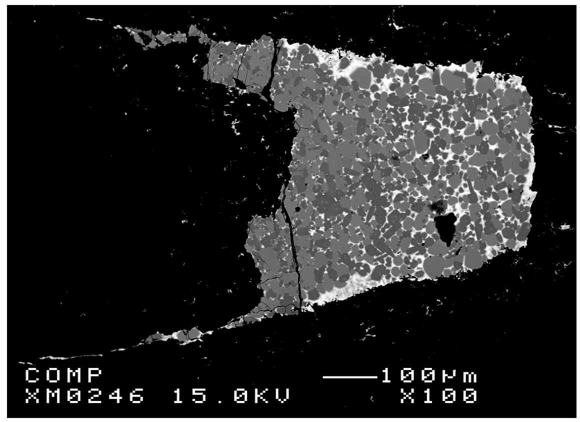

Figure 1: Backscatter image of polished run product for experiment at 1.5 GPa, 1200°C for 104h. Pyroxenes (dark grey) and olivine (light grey) coexist with a Ti-rich liquid (bright areas).

Preliminary results: Our first set of experimental runs (e.g. Fig. 1) shows a very wide liquid+crystal temperature range for this composition. At 1.5 GPa, the liquidus is above 1600°C and the solidus below 1100°C. At this meeting we will present a full phase diagram for this newly proposed lunar bulk composition.

References: [1] Shearer C. K. et al. (2006) in *New Views of the Moon*, 365-518. [2] Khan A. et al. (2006) *EPSL* 248, 579-598. [3] Khan A. et al. (2007) *Geophys. J. Int.* 168, 243-258. [4] Taylor S. R. (1982) *Planetary Science*, LPI, Houston TX, 322pp. [5] Hart S. R. and Zindler A. (1986) *Chem. Geol.*, 57, 247-267. [6] De Vries J. et al. (2009) LPSC 40, abstract 1244.