Rare SiO_2-rich achondrites are ubiquitous primary melts of chondrites

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The number of achondrites rich in Si, Al, Na and containing abundant oligoclase (plagioclase An 10-30) has grown in the last decade (e.g. GRA 06128/06129 [1], ALM-A [2], NWA 6698, NWA 11575 [3]). New experiments show that despite their high SiO_2 concentrations, those meteorites likely represent the partial melts of chondrites rather than "evolved" rocks produced by igneous differentiation [4-6].

To constrain the formation conditions and the composition of the parent bodies of Si-rich achondrites, we are conducting partial melting experiments from several chondritic compositions (CM, CV, H, LL, H+CM) at different fO_2 (IW+1 to IW-3), temperatures (1070-1150 ºC) and pressures (1-100 bars).

We find that small changes in the (Na+K)/Ca ratio of the chondritic material have a strong effect on the solidus temperature and the composition of low-degree melts. Chondritic materials with low (Na+K)/Ca ratios (CM, CV) contain labradorite (An 50-60), melt at >1130 ºC and do not produce partial melts rich in Si-Al-Na. Chondrites with high (Na+K)/Ca ratios (e.g. H, LL) contain oligoclase (~An 15), melt at <1080 ºC and produce 10 % of Si-Na-Al-rich melts.

Our experiments indicate that Si-Na-Al-rich melts were commonly produced and mobilized during the partial melting of planetesimals with a 100 km radius. Numerous equilibrated chondrites (petrologic type 6-7) and primitive achondrites contain oligoclase, suggesting that they would have started to melt at low temperature and produced significant fractions of Si-Na-Al rich melts. The ureilites, which are primitive achondrites heated >1200 ºC, must derive from chondrites that lost Si-Al-Na-rich melts during a first stage of melting (<1120 ºC) [6].

Despite being sampled in only a few plagioclase-rich achondrites, migrating Si-Na-Al rich melts may have been ubiquitous at the onset of silicate melting within many planetary bodies. Such melts would concentrate the ^{26}Al of small planetesimals and would significantly impact their thermal budget and differentiation processes.

[1] Shearer *et al*. (2008), *Am. Mineral*. **93**, 1937-1940. [2] Bischoff *et al*. (2014), *PNAS* **111**, 12689-12692. [3] Agee *et al*. (2018), 49th LPSC, #2083. [4] Usui *et al*. (2015), MAPS **50,** 759-781. [5] Lunning *et al*. (2017), GCA **217,** 73-85. [6] Collinet and Grove (2018), 49th LPSC, #1841.