NWA 8694 AND THE CHASSIGNITE PARENT LIQUID PROBLEM. R.H. Hewins1,2, J.-A. Barrat3, M. Humayun,4, S. Pont1, B. Zanda1,5. 1IMPMC, MNHN, 75005 Paris, FR. 2Rutgers University, Piscataway, NJ 08854, USA. 3UBO-IUEM and CNRS UMR 6538, 29280 Plouzané, France 4Florida State University, Tallahassee, FL 32310, USA. 5IMCCE, Observatoire de Paris, 77 Av. Denfert Rochereau, CNRS UMR 8028, Paris F-75014, France. (hewins@rci.rutgers.edu)

Introduction: NWA 8694 is more ferroan than the two other chassignites, pigeonite is the second most abundant phase, and REE concentrations of phases are similar to those in the other chassignites [1]. Augite is similar in composition to the most magnesian augite in nakhlites. We attempt here to clarify the formation of chassignites and their relationships with nakhlites.

Geochemistry: LA-ICP-MS analyses were performed at the NHMFL, Florida; 72 elements were measured on individual mineral grains with spot sizes of 25 or 50 µm and 5-second laser dwell time per spot, or with 100 µm spots and 20-second of laser dwell time per spot, at 50 Hz laser repetition rate. A bulk analysis of NWA 8694 was performed on the reverse side of the NWA 8694 mount with a 150 µm spot size, rastered at 50 µm/s with 50 Hz laser repetition rate, covering an area of 7 mm x 5 mm. ICP-AES and ICP-SFMS analyses were also made on 0.136g of homogenized powder at IUEM Plouzané.

Results for normalized REE are shown below:

Parent Liquids: NWA 8694 is a heteradcumulate dunite, containing 85% olivine and ~11% pyroxene, both phases being equilibrated in Fe-Mg. We take the trapped melt as a basis for estimating the composition of potential parent liquids. A grid of basaltic melts was calculated by first adding different amounts of pyroxene to trapped melt, and then adding various amounts of olivine to each result, using the LA-ICP-MS analyses. The REE pattern of one of many parent was arbitrarily selected shown in be shown in the second figure.

These melts are not in equilibrium with the observed olivine and crystallize magnesian olivine (Fo≥75). As has been done for Chassigny [2], we correct the FeO/MgO of the calculated potential parents using Kd and maintain a martian Fe/Mn ratio.

Individual melts were selected as potential parents and crystallized using PETROLOG [3] for a pressure of 1 bar, and an oxygen fugacity of QFM-2 log units. All these olivine-saturated liquids with Fe/Mg adjusted fractionated olivine with average composition close to that observed, as shown in the figure above. The order of pigeonite, augite and plagioclase depends on the model chosen within PETROLOG for the olivine.
All the daughter liquids are subalkaline to very weakly alkaline, and do not achieve the high Na$_2$O+K$_2$O of the trapped liquid, as indicated in the following figure:

Chassignites and nakhlites have many properties in common, including the similar REE spectrum for bulk chassignites and mesostases in nakhlites [4]. The trapped liquid in NWA8694 has similar LREE abundances to those mesostases, but is depleted in HREE (last figure). This plus its high alkali content suggests the latest liquids have been disturbed. The wide range of Fe/Mg ratios in these rocks is a problem for an origin by fractional crystallization of a single magma in a sub-volcanic environment. More complex models involving Assimilation-Fractional Crystallization (AFC) may be required but the parameters for the assimilant needed are difficult to determine from a single meteorite. A wider study of melt inclusions from both nakhlites and chassignites, or new meteorites would be helpful.