ESRF	**Experiment title:** Density measurements of liquid Fe, Fe-C and Fe-Si alloys at high pressure and high temperature by an X-ray absorption technique	**Experiment number:** HS1828
Beamline: ID30	**Date of experiment:** from: 19 June 2002 to: 24 June 2002	**Date of report:** 27 February 2003
Shifts: 15	**Local contact(s):** Dr. Wilson Crichton	*Received at ESRF:*

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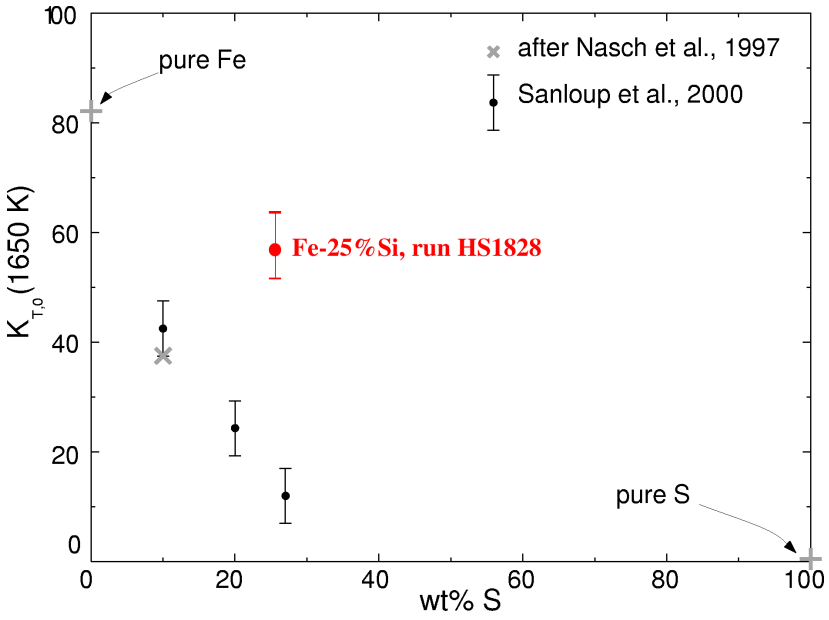
Report:

Knowing the physical properties of Fe-based liquids would greatly improve our understanding of the current state of planetary cores as well as their formation. Two major scientific issues are: 1) what are the equations of state of these liquids?, and 2) what are the structural changes in the liquid at the atomic scale with increasing pressure and temperature, and their dependency upon the nature and amount of alloying light element?

These questions have been answered for Fe-S liquid alloys from previous ESRF runs (Sanloup et al., 2000a): a strong effect of sulfur on the bulk modulus (K_0) of liquid iron was evidenced (see Fig. below) correlated with a large degree of disorder in structural data compared to pure liquid Fe (Sanloup et al., 2000b). From structural data only, we could infer that Si does not strongly affect K_0 since it only slightly modifies the structure of liquid Fe (Sanloup et al., 2002). The preliminary results we got during this run HS1828 tend to confirm this prediction (see Fig. below).



To measure the density of liquid Fe-Si alloys, we had to overcome the reactivity of the sample with its sapphire container. This sapphire container usually helps to precisely constrain the size of the sample on the absorption scans, besides, it deforms elastically and does not flow. The solution we adapted was to replace the sapphire container by a single-crystal diamond capsule, which proved not only to be inert respectively to liquid Fe-Si but also to increase the precision on density measurements, C being much lighter than Al_2O_3.

Unfortunately, due to thermocouple insertion slits in the anvils we used during this run, most of the cell-assemblies got destabilized upon increasing temperature by extrusion of material in the slits. Meanwhile, we got enough data points for one composition, Fe-25wt%Si. The fitted equation of state at 1750 K gives a bulk modulus, K_0, of 58 GPa, much closer, though still lower, to the bulk modulus of pure liquid Fe than a Fe-25wt%S liquid (see Fig.).

References:

C. Sanloup et al., 2000a, Geophys. Res. Lett., 27, pp.811.
C. Sanloup et al., 2002, J. Geophys. Res., 107, pp.ECV-4.