# Strong affinity of Al-containing bridgmanite for ferric iron

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It is well established that bridgmanite has a strong affinity for ferric iron in the presence of Al, and that the amount of ferric iron relative to total iron can strongly influence both physical and chemical properties of the phase, and in turn the entire lower mantle. Recently, however, there have been resports that under certain conditions, Al-containing bridgmanite will contain substantially less ferric iron than previously supposed. One possibility is that particular compositions may stabilise ferrous iron relative to ferric iron, for example where Al substitutes equally on both sites of the perovskite structure, thereby balancing divalent iron and tetravalent silicon. To explore this possibility as well as perform a more comprehensive investigation of the effect of temperature and oxygen fugacity on ferric iron concentration in Al-containing bridgmanite, we carried out a study combining multianvil experiments with Mössbauer spectroscopy.

We synthesised a glass with nominal composition 0.9 $MgSiO_3$ (enstatite) + 0.1 $(Fe_{0.75}Al_{0.25})(Si_{0.75}Al_{0.25})O_3$ (almandine). Starting materials for the multianvil experiments were (1) the glass as synthesised in air ($Fe^{3+}/\Sigma Fe = 0.5$), and (2) the glass after reduction in a $CO/CO_2$ gas furnace ($Fe^{3+}/\Sigma Fe = 0$). All multianvil experiments were performed at 26 GPa with different combinations of starting material (oxidised or reduced glass), temperature (1600°C or 2000°C) and capsule material (Fe or Re). A final experiment was performed at 1600°C and then the run product was re-equilibrated in a new multianvil experiment at 2000°C.

All experiments produced bridgmanite with $Fe^{3+}/\Sigma Fe$ values between 45% and 66%, consistent with previous results. While there was no obvious influence of oxygen fugacity or temperature on $Fe^{3+}/\Sigma Fe$, we did observe changes in the shape of the Mössbauer spectra, consistent with an influence on the distribution of iron between cation sites. Since this distribution also affects physical and chemical properties, for example spin transitions, further analysis is underway to quantify the effect, as well as parallel experiments using a laser-heated diamond anvil cell.