Zeolite Amorphisation, towards the synthesis of a 'perfect' glass.

G.N. Greaves*, F. Meneau*[§], O. Majérus*[#], D.G. Jones * & J. Taylor[†]

**Institute of Mathematical and Physical Sceinces, University of Wales, Aberystwyth, SY23 3BZ, UK*

[§]*Netherlands Organisation for Scientific Research (NWO), DUBBLE CRG/ESRF, PO Box 220, F38043 Grenoble Cedex, France*

[#]*ENSCP, 11 rue Pierre et Marie Curie, 75231, Paris, France*

[†]*ISIS Facility, Rutherford Appleton Laboratory, Chilton, OX11 0QX, UK*

Using high resolution inelastic neutron scattering major sources of low-frequency vibrations have been observed in zeolites [1]. Dispersed and non-dispersed modes are found, both of which are prominent in the early stages of compressive amorphisation but decline dramatically in strength once a glass of conventional density is created. X-ray powder diffraction on BM26 was used to determine the fraction of zeolite remaining at each stage and this was used to deconvolute the amorphous from the crystalline components for both types of vibration. By identifying the dispersed modes with the characteristic vibrations of the various secondary building units (sbus) of zeolitic structures, the Boson Peak, ubiquitous in the glassy state, can be attributed to vibrations within connected rings of many different sizes. These are also prominent throughout zeolite collapse in the amorphised component and as such are associated with a low density glass. They are much weaker in the final high density amorphous phase, where the larger rings of the zeolite sbus become degenerate with the smaller rings that characterise the continuous random networks of conventional glasses. The non-dispersed phonon features in zeolites, which are retained in the amorphised glass, are also replicated in silica. It is proposed that these are librational in origin and responsible both for destabilising the microporous crystalline structure and also for converting the resulting glass from a low to a high density phase.

[1] Identifying the vibrations that destabilise crystals and which characterise the glassy state. Greaves GN, Meneau F, Majérus O, Jones D and Taylor J *Science* **308**, 1299-1302 (2005) - highlighted in *This week in Science* 308, 1221 (2005)