29SI NMR TECHNIQUES IN ENGINEERING GEOLOGY

1FORERO-DUEÑAS, C.A. and 2LICKISS, P.D. 1Ingeominas, Diagonal 53 #34-53, Santafé de Bogotá, Colombia; 2Imperial College of Science, Technology and Medicine, Department of Chemistry, London SW7 2AY, UK.

Field evidence shows that amorphous silica-gels can exist in natural environments. It is proposed that such gels are able to integrate with their surroundings originating coherent masses that respond as a unit when stresses are applied. Monosilicic acid, Si(OH)4, monomers undergo polymerisation, and are organised in chains and rings forming first a sol and, when the polymerisation is far enough advanced, a gel.

Chemical techniques are applied to complement more traditional enginering geology tests, to follow the transition from a sol (liquid-like engineering response) to a gel (solid-like response), with an increase in the siloxane bonds (Qn). The 29Si nucleus has a 4.7% natural abundance and has been used for Nuclear Magnetic Resonance (NMR) spectroscopic studies to gels produced in the laboratory. They were formed by adding a 1M solution of HCl dropwise to a mixture of sodium silicate solution and water; such a material changed from a sol to a gel and the changes were followed with 29Si NMR. The NMR spectra were recorded using a Bruker MSL 300 spectrometer at 59.627 MHz for 29Si; magic angle spinning at between 3.2 and 3.3 kHz and a pulse sequence with a recycle time of 3s and a pulse width of 1.5ms. 3600 scans were averaged at each time to give the spectrum.

At 2.75 h resonances are at about -67.3, -74.3, -90.2, -100.6 and -110.8 ppm attributed to Q0, Q1, Q2, Q3 and Q4 silicon species respectively. As time progresses the resonances for Q3 and Q4 increases and becoming dominating, as the gelation progresses.