# ****EBS-Workshop on Nuclear Resonance Scattering****New frontiers in geoscience with submicron SMS

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Mössbauer spectroscopy has long enjoyed a favoured place in the analytical toolbox of geoscientists since it is practically unique among other methods. The signal is specific to the nucleus being examined, so only those phases containing the Mössbauer isotope give a signal. It is one of the few methods that is able to distinguish different valence states, and one of the even fewer that require no calibration to determine accurate values of relative abundance. Finally, there is practically no limitation on pressure and also to a certain extent temperature, which means that Mössbauer spectroscopy can be carried out on samples at most conditions within Earth’s interior.

Technical advances have reduced the beam size dramatically, initially as radioactive point sources became available and subsequently through advances in focussing capabilities at synchrotron facilities. The synchrotron Mössbauer source (SMS) brought the advantages of energy domain measurements to the synchrotron. At first, research questions involving high pressure were the main driver of these developments, but natural samples have also been in the limelight since they may be small and their history can often be deciphered from inhomogeneous variations in composition and oxidation state.

Geoscience is full of examples where increased spatial resolution has led to large leaps in knowledge. For example, the shift from whole rock analysis by mass spectrometry to single grains led to the discovery of 4.4-billion-year-old zircons, nearly as old as Earth itself. While the progressive reduction in Mössbauer beam size from one cm down to 10 microns has brought many discoveries, the advantages of micron or submicron beams have eluded the Mössbauer community. This will change with the implementation of submicron beam focussing at the nuclear resonance beamline. The presentation will highlight applications that have the potential to substantially advance knowledge in geoscience. These include heterogeneous samples whose patterns unlock key parts of Earth’s history and multiphase diamond anvil cell experiments that mimic crucial processes occurring in Earth’s interior.