Elastic anomalies due to spin state transitions in cobaltate perovskites: Analogue behaviour for Fe^{2+} in $(Mg,Fe)SiO_3$

ZHIYING ZHANG[1]*, JOHANNES KOPPENSTEINER[2], WILFRIED SCHRANZ[2] AND MICHAEL A. CARPENTER[1]

[1]Department of Earth Sciences, University of Cambridge, Downing Street, Cambridge CB2 3EQ (*correspondence: zz254@cam.ac.uk)
[2]Faculty of Physics, University of Vienna, Strudlhofgasse 4, A-1090, Vienna, Austria

$(Mg,Fe)(Si,Al)O_3$ perovskites with orthorhombic *Pnma* structure and (Mg,Fe)O are the principal minerals of the Earth's lower mantle. Fe^{2+} undergoes spin state transitions at high pressure and high temperature, which have important effects on the physical properties of the lower mantle. Fe^{2+} in (Mg,Fe)O changes from high spin state to low spin state with increasing pressure, leading to large changes in the bulk modulus and small changes in the shear modulus. However, the influence of spin state transitions on $(Mg,Fe)(Si,Al)O_3$ are less clear. There are still controversies about the nature of the stable spin configuration at high pressure and high temperature, the extent of the effect of spin state transitions on elastic properties and so on. It is hard to investigate the elastic moduli and acoustic dissipation at high pressure and high temperature. Therefore, analogue materials have been made use of. Co^{3+} is isoelectronic with Fe^{2+}, and undergoes spin state transitions as a function of temperatue at ambient pressure. We have investigated elastic anomalies and acoustic dissipation associated with spin state transitions of Co^{3+} in $NdCoO_3$ and $GdCoO_3$ perovskites (orthorhombic, *Pnma*) using resonant ultrasound spectroscopy at high frequencies (0.1-1.5 MHz) and dynamic mechanical analysis at low frequencies (0.1-50 Hz). Strain analysis based on lattice parameter data from the literature shows that the spin state transitions are accompanied by significant variations in shear strain due to the change in ionic radius of Co^{3+}. Spin state/strain coupling via octahedral tilting leads to the renormalization of shear modulus. In $NdCoO_3$, the shear strain is small, and thus the coupling is weak. The temperature dependence of the shear modulus scales semi-quantitatively with an empirical spin order parameter. On the other hand, large shear strain and strong coupling occurs in $GdCoO_3$, and large softening of the shear modulus by up to ~35% has been observed, accompanied by enhanced acoustic dissipation. The large shear strain associated with octahedral tilting in $(Mg,Fe)SiO_3$ at high pressure suggests similar elastic behaviour as in $GdCoO_3$.

Structure and mineralization characteristics of Kangding gold orefield, Sichuan Province, China

ZHANG ZHIJUN[1 2], DENG JUN[1], GONG QINGJIE[1] AND WANG QINGFEI[1]

[1]China University of Geosciences, Beijing, 100083
[2]Tianjin North China Geological Exploration Bureau, Tianjin, 300170

The Kangding gold orefield, located in the north part of the 'kangding complex' block and Sanjiang ore cluster area, has great potential in mineral resources. Based on the geological settings, the gold deposits in the study area are divided into two series : one series is in Kangding complex and the other is in the Xiaojin area with arc-shaped structures. Orefield structure, ore deposit geochemistry and metallogenic model are studied and compared between the two series. The rocks mainly contain amphibolite, granite, granulite, and basic dikes. The Kangding complex has experienced the formation of the basement from Neoarchean to the Paleoproterozoic, the Neoproterozoic magmatic activities (between 860-750Ma.) with the mountain of the main body, Mesozoic Indo-Chinese - Yanshanian magmatic activity, as well as the Cenozoic Himalayan magmatic activities. Magmatic activities are closely related to the formation of gold mineralization. Kangding complex is characterized by two layers which are crystalline basement and fold basement. It is a mixture of metamorphic and magmatic complex, and is the product of regional metamorphism, deformation and partial melting of magmatic rocks since Proterozoic.