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Reflection seismic and potential field studies of the Alnö alkaline and carbonatite complex - preliminary results

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The Alnö complex in central Sweden is one of the largest (5 km by 5 km) of the few known alkaline and carbonatite intrusions in the world. It contains a wide variety of lithological units including alkaline igneous rocks (Ijolite, Nephelinesyenite, and Pyroxenite) and a range of carbonatitic dykes with differing composition (Kresten, 1990). Alnö is the type locality for Alnöite, which occurs as dykes and contain phenocrysts from deep crust and upper mantle. They have been investigated for diamond exploration, although no diamonds have been found. There have also been small scale mining for iron, barite and limestone in the intrusion area, but no such production occurs nowadays. Geochronological measurements suggest an age of 553-590 Ma for the main intrusion. There is also some evidence for an explosive extrusion vent in the complex north of the main intrusion, which is (if exist) a globally unique example of a large extrusive carbonatitic vent. A 500-600 m wide zone of the wallrock surrounding the intrusion has been metasomatised from surrounding migmatite to fenite through fluid-rock interaction. The structural relationships as well as the depth extent of the main lithological units associated with the complex are poorly known at depth. The depth extent, dip and dip direction of carbonatite rocks have been only speculated upon from surface geological observations and, hence, require robust constraints. The intrusion mechanism(s) is a matter of controversy and of great interest to geoscientists both nationally and internationally.

This research work aims to improve understanding of the intrusion mechanism(s) and the geometry of alkaline and carbonatite intrusions, in general, using the Alnö complex as an example. An integration of upper crustal scale reflection seismic data, potential field data modeling, point-wise measurements of physical rock properties and surface geological observations will be used to construct a 3D model of the main intrusion in near future. Three high-resolution reflection seismic profiles crossing the intrusion are planned to be acquired in March 2011. Densely sampled surface gravity and magnetic data were collected in summer 2010 along the planned seismic profiles. The gravity measurements indicate a strong positive Bouguer anomaly of about 20 mGal over the intrusion. A few oriented rock samples were also collected for petrophysical measurements including compressional- and shear-wave velocities, anisotropy of magnetic susceptibility (AMS), density and conductivity. Seismic velocity measurements clearly indicate that the Alnöite, Pyroxenite and Carbonatite should produce strong positive reflection coefficient if juxtaposed with the migmatite and fenite. A calcium rich rock, known as the Sövite, should also produce strong negative reflection coefficient if occurs within or at the contact with the Alnöite, Pyroxenite and/or Carbonatite. We will attempt to present field seismic brute stacks and discuss their preliminary interpretations.