Basement Depth and Stratigraphic Thickness Solutions from Modeled Gravity Data for the Tanana and Nenana Basins and Implications for CO_2 Sequestration

Tomsich, Carla S.[*1]; Hanks, Catherine L.[1]; Coakley, Bernard J.[1]
(1) Geophysical Institute, University of Alaska, Fairbanks, AK.

Options for carbon sequestration are needed to support carbon-neutral power generation in Interior Alaska. One local option is storing CO_2 in deep coal intervals of the Neogene Usibelli Group in the Tanana and Nenana basins. This fluvio-lacustrine sequence crops out on the flanks of the northern Alaska Range where it is mined for coal. However, the depth, thickness and subareal extent of the Usibelli Group in both basins are poorly constrained. Potential field data can be used to evaluate their utility as carbon reservoirs.

To begin this process, a series of profiles were constructed across both basins using State of Alaska (DNR) Complete Bouguer Gravity and Aeromagnetic anomaly maps. Basin stratigraphy was constrained with published and proprietary data from 3 test wells drilled into the Nenana Basin, residential water wells and limited seismic reflection data. The projected stratigraphy was converted into a density model with well log data. Magnetic susceptibility and density were measured from outcrop samples. The hypothetical gravity and magnetic response for the 2-D models of the density and magnetic properties were calculated using Geosoft GM-SYS. Assumptions were made for older basin fill in the Nenana Basin, sediments and sedimentary rocks underlying the Tanana Basin and local ophiolitic rocks within the crust.

Gravity and magnetic models consistent with the observed anomalies indicate the central Tanana Basin is a shallow topographic basin built on a crystalline basement with variable relief. Depth to basement (excluding local intra-basinal highs) ranges between 200m to 800m. Small, isolated, fault-bounded depressions no more than 7 km across reach a depth of up to 1200m. Gravity models of the southern Tanana Basin support depths of up to 2000m in structural lows adjacent to the Alaska Range. Thickness estimates for Usibelli Group and possible remnants of older sedimentary rocks range between 300m and 800m in the middle Tanana Basin and between 800m to 1200m in the southern Tanana Basin.

In contrast, the Nenana Basin is depicted clearly by a large gravity low. This ~100 km long and up to 20 km wide basin, presently the target of natural gas exploration, is a narrow, fault-bound trough. Gravity models show two distinct depo-centers that are 4000m and 6000m deep respectively. Basin fill consists of five depositional sequences of low and medium densities. Using the gravity models, a maximum thickness estimate for the Usibelli Group in this basin is 1400m. Caliper, density and resistivity logs suggest significant amounts of coal.

Effective CO_2 sequestration relies on thick, deeply buried coal sequences. Areawide Usibelli Group is overlain by a thick cover of poorly consolidated conglomerate, sand and silt (Nenana Gravels), glacial deposits, and recent alluvial fan and fluvial sediments. Given the variable

depth estimates and poor stratigraphic constraints for the Tanana Basin, we conclude that the Nenana Basin has more assured CO_2 sequestration potential.