Why Cook Inlet is so Special (Geophysically)

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Geophysically speaking, Cook Inlet is a special place. It falls on a regional magnetic high with amplitude (regional values greater than 500 nT at a compilation height of 1 km) among the largest on Earth. This magnetic high represents an extensive, deep and cold crust with substantial mafic content. The complex gravity signature of Cook Inlet is overall anomalously low (complete Bouguer gravity lows to -150 mGal at sea-level elevations) although it overlies a generally thick and dense crust. The Bouguer gravity signature is a complex combination of (1) a basin-centered low from the Tertiary and other Cenozoic rocks in the Cook Inlet basin plus (2) a basement gravity high from the mafic Wrangellian crust and (3) a broad deep regional low from unusually thick crust. The thick crust indicates a departure from isostatic balance that is reflected in the complex geoid expression for Cook Inlet. The Cook Inlet geoid consists of a distinctive 10 m depression superimposed on a broad, 15 m southern Alaska regional geoid high. The Cook Inlet geoid depression reflects apparent isostatic over compensation and probably relates to mantle dynamics, perhaps down-welling. The broad southern Alaska regional geoid high reflects extensive apparent isostatic under compensation and may reflect topography supported by lateral forces, mantle dynamics (i.e., up-welling), or high flexural strength of the lithosphere. These geophysical characteristics and others constrain the regional crustal framework of Cook Inlet and provide a background for more detailed geophysical interpretation for structure and geodynamics. We have developed a series of 2-dimensional cross-section models to integrate, illustrate and explain the geophysical framework of Cook Inlet. These models depict physical property (density and magnetic susceptibility) blocks that relate to the tectonic history and on-going tectonic development of active faults and structures.