Structural and Stratigraphic Evidence for Transtensional Control of Paleogene Syn-tectonic Deposition along the Northwestern Periphery of the Cook Inlet Forearc Basin

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The boundary between the modern Cook Inlet forearc basin (CIFB) and the active magmatic arc to the NW is delimited by a system of NE-trending faults with slip histories widely believed to have been governed by dextral oblique transpression throughout most of Cenozoic time. New 1:63,360-scale geologic mapping of Cenozoic sedimentary strata and granitic rocks exposed along the NW periphery of the CIFB near the base of Mt. Spurr reveal that deformation during early Tertiary time was, at least locally, transtensional. A system of well-exposed high-angle faults in the area consists of a NE-striking master fault (Capps Glacier fault, or CGF), sub-parallel subsidiary faults, and several SE-striking faults with relative orientations consistent with synthetic riedel shears in a dextral setting. New zircon U-Pb analyses of footwall granitic rocks and volcanoclastic beds intercalated with syntectonic West Foreland Formation hangingwall strata help constrain the timing and sequence of deformation in the area. Fault kinematics and cross-cutting relationships indicate that oblique-normal deformation occurred primarily along NE-striking faults after ~59 and prior to ~ 45 Ma, whereas the same slip sense favored mostly SE-striking faults after ~45 Ma. Minor reverse reactivation may have occurred along NE-striking faults after transtensional deformation ceased. Consequently, the documented potential for polyphase, bi-directional, non-plane strain deformation near the basin periphery warrants extra caution when interpreting subsurface information from near the NW CIFB margin.

The only known surface expression of the CGF occurs for ~4 km in this area, yet it likely continues in the subsurface to the NE ~40 km toward the margin of the Susitna basin, and possibly extends even farther to the SW through granitic rocks. Vertical throw accommodated by the CGF is probably less than ~4.5 km based on AFT results with near-intrusive cooling ages from exhumed footwall granite. Lack of reliable piercing points along the fault hamper an estimate of horizontal displacement, but it is conceivably as great as 15 km. The CGF may therefore represent the NW-most forearc-bounding fault in the region that was active chiefly during Paleogene time. The mechanism for transtensional deformation in the area is unclear, but may be related to communication between the CGF and the dextral Castle Mountain fault (CMF) to the east. The right-stepping relationship and relative motion between the faults would have been conducive to pull-apart basin formation between their termini. Transpressional deformation may have resumed in the area after inception of the Lake Clark fault, and its eventual linking with the CMF, after Late Oligocene time. Thus, the structural and stratigraphic relationships observed in Tertiary exposures near Mt. Spurr potentially shed light on the early Cenozoic kinematic evolution of the northwestern CIFB margin.