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AN: **T33G-04 INVITED**
TI Crustal Accretion and Denudation Processes at Slow Spreading MOR - Insight From IODP Hole U1309D (MAR 30° N)

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AB IODP Hole U1309D penetrated a dominantly gabbroic crustal section to 1415.5 mbsf with average recovery of 74%, providing an unprecedented view of the interplay between magmatism, deformation, and alteration prior to, during, and subsequent to detachment faulting. Detailed shipboard results include the following: 1) Hole U1309D cored a section of primitive to evolved gabbroic rocks, dominated by inter-layered gabbro (91% of the core), ultramafic rocks, including olivine-rich troctolite and plagioclase-bearing peridotite (5%), and basalt and/or diabase (3%). Relative to gabbroic rocks sampled during ODP Legs 153 and 209 from the MAR, and ODP Hole 735B from the SWIR, Site U1309 gabbros are more primitive as indicated by high Mg# (74 to 90), and low TiO2 (<0.49 wt%) and low Na2O (0.1-3.7 wt%). 2) Gabbroic rocks from Hole U1309D comprise sequences of more primitive olivine-rich troctolite to olivine gabbro, gabbro, gabbronorite and oxide gabbro, intruded by both leucocratic dikes, and diabase sheets. Hundreds of sharp igneous contacts were recovered, with gabbro consistently intrusive into olivine gabbro and troctolite, and in turn intruded by felsic dikes and/or oxide gabbro. 770 igneous units were logged on Expedition 304/305. Based on cross-cutting relations, these form several hundred intrusive pulse, implying the average building block of lower oceanic crust at this locality is < 5 m thick. 3) Highly altered ultramafic rocks of possible mantle origin were recovered in 4 thin intervals in the upper 220 m of the hole (thickness 140 cm; 0.3% of the core), and range in composition from harzburgite to dunite. All show evidence for melt impregnation. 4) Structural observations for Site U1309 show a surprising lack of deformation immediately below

the hypothesized detachment fault. The drilled gabbro section is structurally homogeneous, except for a few (3% of the core) cm-scale zones of crystal-plastic and brittle deformation in the upper ~320 mbsf and between 650 and 800 mbsf. Although the upper 20 meters of Hole U1309D was cased, talc-tremolite schist similar to fault rocks recovered from the southern ridge at Atlantis Massif, and at 15° 45'N on the MAR was recovered in Hole 1309B, and one shallow penetration hole adjacent to U1309D. These relations suggest that intense strain is either very localized, and restricted to the upper 20 meters of the central dome, eroded, or not present. 5) The overall magnetic inclination in the hole between 180-1415 msbsf is -37°, implying significant (40-50° ccw) rotation about an axis subparallel to the present-day ridge (010°). These data are consistent with a rolling hinge model for core complex evolution. Conversely, the upper 180 m show an inclination of -49° consistent with either zero or 15° ccw rotation. The presence of normal polarity overprints and complex multicomponent remanences, provide evidence that construction and/or cooling spanned more than one polarity interval. 6) Metamorphism/alteration in Hole U1309D extends from granulite to zeolite facies; the downhole alteration profile reflects incursion of seawater during cooling from magmatic conditions. Upper greenschist/lower amphibolite facies alteration is pervasive above 350 mbsf. Below 800 mbsf, samples are nearly unaltered. Clay and zeolite-rich veins, particularly below 700 mbsf, represent the lowest temperature alteration and may be forming today, as logging data reveals that the base of the hole is currently > 120°C.

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