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EVIDENCE FOR ONGOING MAGMA RECHARGE AT MOUNT ST. HELENS, WASHINGTON

MORAN, S. C., USGS, Vancouver, WA, USA, smoran@usgs.gov; LISOWSKI, M., USGS, Vancouver, WA, USA, mlisowski@usgs.gov

Since the last eruption of Mount St. Helens (MSH) in 2004-2008, earthquake rates of M > 0 per year have been slightly lower (95 located events per year) than in the five years prior to 2004 (115 per year). This is in marked contrast to the five years immediately following the 1980-86 eruptive period, when the yearly average rate was 400 events and there was clear evidence, in the form of rotated fault-plane solutions (FPS), that magma recharge was occurring at depths > 2 km. However, analysis of 55 FPS from 2008-2013 show that stress fields at depths > 2 km are significantly different from the regional stress field, with most P and T axes quasi-horizontal and on average rotated ~30 degrees. These patterns are broadly consistent with repressurization occurring within the magmatic system. The majority of these FPS come from 2012-2013, when there was also a significant increase in the number of events occurring at depths > 2 km. Additional evidence for recharge comes from deformation trends observed on the GPS network that has been in place at MSH since 2004. Decaying inward and downward motion of nearby GPS stations accompanied the 2004-2008 eruption. This deformation reversed after the eruption stopped in January 2008, eventually recovering about half of the observed deflationary deformation before leveling off in the last several years. Deformation modeling indicates that a deep magma source, best fit by a 7-km-deep vertically elongate prolate spheroid, fed the eruption and was partially recharged in the years after the eruption stopped. Although recharge is indicated by these trends, we infer that the rate of recharge in 2008-2013 is much less than in 1987-1992 based on the lower seismicity rates and seismic moment release.

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