Slow-Slip and Fluid Flow Response Offshore New Zealand (SAFFRONZ) - Probing the nature of the Hikurangi margin hydrogeochemical system

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Fluid generation, migration, and pore fluid pressure at subduction zones are hypothesized to exert a primary control on the generation of seismicity, low-frequency earthquakes, and slow slip events (SSEs). The SAFFRONZ (Slow-slip and fluid flow response offshore New Zealand) project addresses the GeoPRISMS Subduction Cycles and Deformation Initiative Science Plan by testing interrelationships among fluid production, fluid flow, and slow slip at the Hikurangi Margin. The recognition of dramatic changes in the along-strike distributions of SSEs and their recurrence intervals, interseismic coupling, inferred pore pressure, and other subduction-related parameters at the Hikurangi margin have resulted in a concerted international effort to acquire seismological, geodetic, other geophysical, and geomechanical data both onshore and offshore the Hikurangi margin. This effort includes recent scientific ocean drilling, logging, and the deployment of two subseafloor observatories during IODP Expeditions 372 and 375, as well as a 3D seismic reflection survey on the northern margin. SAFFRONZ complements and extends these efforts by providing 1) a continuous two-year record of fluid flow rates and composition through the 2019 slow slip event, 2) information on the present background state of fluid flow and how it relates to inferred pore fluid overpressure along the plate boundary, and 3) comparative geochemical and hydrologic data between the northern and southern sections of the margin. Our field strategy combined ship operations and ROV surveys in a nested approach to constrain the margin-wide fluid flow distribution. Coring, heat flow measurements, and benthic fluid flow meter deployments targeted fault-hosted seep sites and off-fault locations from the deformation front to the shelf-break at both the southern and northern Hikurangi margin. Continuous fluid flow rate measurements at off-fault locations will quantify the fluid flow response to local volumetric strain during slip, and comparative data at fault zones will provide information on the hydrologic responses to slip. ■

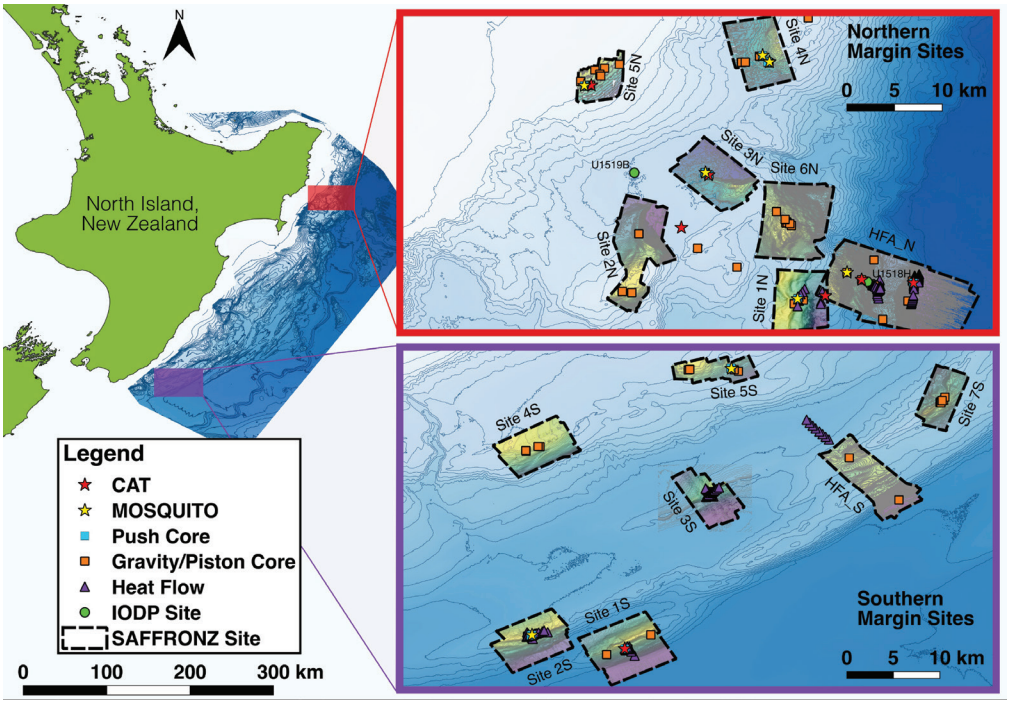

Figure 1. SAFFRONZ core and instrument deployment locations. Map shows all sites surveyed (hydroacoustic and ROV Jason dives) during the 2019 SAFFRONZ research expedition, as well as the locations of cores recovered, heat flow measurments, and benthic fluid flow meter deployments (CAT and Mosquito fluid flow meters).