Some Opportunities for International Scientific Collaboration in the Japan-Kamchatka-Alaska Region

John Eichelberger, Volcano Hazard Program, U.S. Geological Survey (jeichelberger@usgs.gov)
Evgeny Gordeev, Institute of Volcanology and Seismology, FEB RAS (gordeev@kscnet.ru)
Pavel Izbekov, Geophysical Institute, University of Alaska Fairbanks (pavel@gi.alaska.edu)

The Great Tohoku Earthquake of 2011 brings to five the number of M9 earthquakes that have occurred on Earth since instrumental records have been kept. Three of these, or one each, have occurred in Japan, Kamchatka, and Alaska. All produced far-reaching tsunamis. The record of volcanic eruptions is no less impressive, including Katmai 1912, Bezymianny 1956, Shiveluch 1964, Tolbachik 1975, Ksudach 1907, and Usu 1663. More remote, but disruptive to air traffic while lacking ground monitoring networks, are volcanoes like Sarychev (2009) in the Kuriles and Kasatochi (2008) in the Aleutians. At the center of this region the Aleutian and Kurile-Kamchatka arcs and Hawaiian hotspot trace collide, while rollback of the unsupported, torn Pacific plate slab rifts Kamchatka above it[1]. Three Kamchatka volcanoes near this cusp, one basaltic, one andesitic, and one dacitic, are in almost continuous eruption.

Despite the fact that this region lies within or near the territories of three technologically adept countries, segments of it, especially the Kurile and western Aleutian arcs, are among the least studied and most poorly monitored in the world. This is because the resident population is relatively small and the environment harsh. Nevertheless, people do live here, there are resources vital to all three countries, and the importance of the area will further increase as the Arctic opens to shipping. From an American perspective, attention to Alaska by new US scientific initiatives of the U.S. National Science Foundation (NSF) like Geodynamic Processes at Subducting and Rifting Margins (GeoPRISMs), Earthscope, and Creating a More Disaster Resilient America (CaMRA), longstanding partnerships such as the Global Seismic Network (GSN, with USGS, NSF, and Russia's MES and RAS) and the Russian Far East and Alaska volcano observatories (RAS and USGS), together with bilateral discussions among government agencies of the US and Russia, raise the hope of invigorated research into Japan-Kamchatka-Alaska subduction processes. That this is not an idle hope is demonstrated support from NSF and RAS of a large project, within Partners in International Research and Education (PIRE), centered on Bezymianny volcano, involving numerous graduate students, faculty members, and government scientists from Russia and the US. Additionally, ongoing deliberations within the International Civil Aviation Organization (ICAO), following international-scale disruption of aviation by ash eruptions, may eventually provide a path for expansion of ground-based monitoring networks on the region's remote volcanoes. Such networks provide warning in advance of explosive ash eruptions rather than eruption detection only, as is the case for satellite remote sensing, when ash clouds may already block flight routes.

We note two of many possibilities for bilateral or trilateral collaboration here. One would be a region-wide effort to improve and interlink geophysical monitoring, specifically seismic and geodetic networks, and to improve rapidity and accuracy of detection of earthquakes, volcanic unrest and eruption, and tsunamis. This could be accompanied by state-of-the-art seismic and volcano hazard assessments with development of risk mitigation strategies for important communities at risk, such as Petropavlovsk-Kamchatsky and Dutch Harbor/Unalaska, Alaska, bringing together the best methodologies of all three countries. In addition, marine surveys are needed to understand the complex structure of the western portion of the Aleutian arc, including within-arc rifting, block rotation, and submarine volcanism, as coupling of the arc transitions westward from the North American plate to the Pacific plate, and as plate motion transitions from oblique subduction to strike-slip faulting[1]. Without a complementary effort in the Russian Aleutians to extend the reach of GeoPRISMs, the chance to develop a comprehensive whole-arc view will be lost. More broadly, subduction beneath the Kurile-Kamchatka and Aleutian arcs cannot be well

understood without knowing the dynamics of the Okhotsk and Bering microplates on which these arcs are built. Years of collaboration between Japanese universities and Russian Far East institutes have brought considerable detail about Okhotsk plate motion and coupling with the Kurile-Kamchatka arc, but data concerning Bering plate dynamics remains sparse.

A second possibility lies in the area of scientific drilling. Already, significant ocean drilling efforts have been conducted by Japan, Russia, and the US, some as part of the Deep Sea Drilling Program (DSDP), Ocean Drilling Program (ODP), and Integrated Ocean Drilling Program (IODP). Complementary efforts on land have been lacking. In 2006, the International Continental Scientific Drilling Program (ICDP) funded a workshop to develop a proposal for drilling Mutnovsky Volcano's magma-hydrothermal system[2]. A proposal submitted to NSF for pre-drilling geophysical work was not funded, but a drilling project at Mutnovsky remains an attractive possibility that ICDP would consider. In 2008 and 2009, ICDP drilled a young meteor impact crater in Chukotka, El'gygytgyn, for its 3-million-year climate record and to explore the impact structure. The drill rig used was subsequently transferred to Magadan, and remains available for future scientific drilling projects until 2014. This development substantially lowers the logistical costs of scientific drilling at Mutnovsky, or at other targets in Kamchatka. The equipment is capable of continuously coring at HQ size (63.5 mm core, 96.0 mm hole) to 800 m and then NQ size (47.6 mm core, 75.7 mm hole) to 1200 m. Besides Mutnovsky, other attractive targets include the intracaldera stratigraphy of Gorely Caldera and the hydrothermal system, stratigraphy and structure of the flanks of Avachinsky Volcano. Where temperatures are not high, the boreholes could be used to emplace seismometers, tiltmeters, and/or strainmeters in a low-noise environment, thereby enhancing detection and interpretation of volcano unrest.

References cited

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