Geochemistry of volcanic fluids

A special issue of the Bulletin of Volcanology in honour of Yuri A. Taran

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This special issue is dedicated to Yuri Taran's outstanding contributions to gas geochemistry that began in the early 1980s with his work on deuterium and ^{18}O compositions of geothermal waters in the Mutnovsky (Kamchatka) region and continues to this day with work on the Kamchatka volcanic volatile budget, carbon isotopes of hydrocarbons, and new insights into the geochemistry of El Chichón volcano, Chiapas. Yuri has contributed greatly to the field of volcanic gas geochemistry and was the first to recognize the distinct deuterium and oxygen isotopic composition of fumarole condensates from volcanoes in Kamchatka (Taran et al.

1987a). The shift in δD and $\delta^{18}\text{O}$ to significantly heavier values compared to local meteoric water led Yuri to introduce the term “andesitic water” (Taran et al. 1989a, b) which has since been recognized at subduction zone volcanoes globally. This distinct isotopic composition is evidence that volcanoes release water that ultimately originates as subducted seawater and is recycled through the mantle wedge back to the earth's surface. Yuri's early work on the gas emissions from Kamchatka and Kurile Islands volcanoes also included the development and testing of gas geothermometers (Taran 1986) and investigating hydrothermal alteration using isotopic data (Taran et al. 1987b). His curiosity remained focused on the isotope systematics of volcanic gases discharging from Kamchatka and the Kuriles through the late 1980s and 1990s with publications on the gas compositions of Klyuchevskoi (Taran et al. 1991), Mutnovsky (Taran et al. 1992), Avachinsky and Koryaksky (Taran et al. 1997). Yuri was involved in the discovery of a pure and unique rhenium mineral on Kudryavy volcano (Korzhinsky et al. 1994) and provided one of the most detailed chemical studies of high temperature (up to 950°C) fumaroles to date of any volcano (Taran et al. 1995). His 1995 paper on Kudryavy remains highly cited and provides the highest quality volcanic gas data which also include trace elements from a subduction zone. Such data are crucial when we attempt to interpret lower temperature volcanic gas compositions or calculate rare metal fluxes from volcanoes worldwide. His most recent publication on Kamchatka-Kurile volcanic emissions provides a detailed analysis of the total gas flux from these volcanoes (Taran 2009).

After leaving the Institute of Volcanic Geology and Geochemistry in Kamchatka in the mid-1990s and moving permanently to the Universidad Nacional Autonoma de Mexico (UNAM), Yuri's already high productivity literally exploded. He discovered a new country and new volcanoes

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with lots of fumaroles and interesting magmatic-hydrothermal systems as well as a crater lake. Yuri's work on El Chichón provided a comprehensive model of its fascinating sulfur-rich hydrothermal system (Taran et al. 1998) and the dynamics of the crater lake (Rouwet et al. 2008; Taran and Rouwet 2008). His research on crater lakes resulted in several papers with students and colleagues (Capaccioni et al. 2004; Mazot et al. 2007; Mazot and Taran 2009; Taran and Rouwet 2008). He was the first to sample the fumaroles of Everman volcano, Socorro Island, and explained its unique isotope composition and highly reduced gas chemistry (Taran and Cienfuegos 2008; Taran et al. 2002). Together with students he explored the remote Tacana volcano on the Guatemala-Mexico border and first reported the geochemistry of its springs and fumaroles (Rouwet et al. 2009). At Colima, Yuri helped discover a new mineral (Ostrooumov et al. 2009) and showed how elements are transported by highly oxidized gases (Gonzalez-Hernandez and Taran 2005).

Besides being an excellent and rigorous teacher in the field, Yuri has always been firmly grounded in laboratory analyses and theoretical approaches (Osadchii et al. 1997; Taran 2003, 2005; Taran et al. 2007). Yuri's approach to collecting and analyzing samples followed by rigorous and creative interpretation of the results continues to be an inspiration for many scientists working on active volcanic and hydrothermal systems. His continued dedication to the IAVCEI Commission on the Chemistry of Volcanic Gases as president since 2000 is highly valued by the community. We would like to express our greatest appreciation for Yuri's contributions and continued enthusiasm and inspiration by dedicating this volume to him.

The papers in this volume cover a range of topics in volcanic fluid geochemistry that reflect Yuri's interests in volcanology and geochemistry. The papers by Zelenski and Taran discuss the contribution of mantle, slab, and atmospheric contributions to volcanic emissions. Shinohara et al. report spatial and temporal variations of fumarolic gas discharges at Meakan volcano, Japan, and assess the origin of the fumarolic gases formed by interaction of magmatic-hydrothermal systems. Crater lakes are important sources of volcanic volatile emissions; however, fluxes from crater lakes have been poorly quantified. Mazot et al. conducted intensive CO₂ emission rate measurements on and around the crater lake of El Chichón crater lake by applying a floating chamber method. They demonstrate the significant CO₂ and H₂ emissions through the lake. CO₂ and SO₂ emissions as indicators of renewed volcanic activity at Stromboli are discussed by Inguaggiato et al. The paper by Ohba et al. examines temporal variations of chemical and isotopic compositions of fumarolic and borehole discharges at Hakone volcano, Japan, particularly in relation to the occurrence of seismic swarms beneath the volcano. They

propose that injection of CO₂-rich magmatic gases caused the seismic swarm.

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