



Evidences for high gas content beneath the Gorely volcano in Kamchatka (Russia) based on very low Vp/Vs ratio revealed from local earthquake tomography

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The Gorely volcano, which is located at distance of 70 km from Petropavlovsk-Kamchatsky, is one of the most active volcanoes in Kamchatka. Nowadays, a large fumarole inside the volcano crater ejects approximately 11,000 tons of gases daily. During the last thousands years, eruptions in Gorely were mostly basaltic that determined the shield type of the volcano. However, a large caldera of ~20 km diameter dated at approximately 30,000 years indicates that the volcano has high explosive potential. To identify the feeding mechanisms and to assess the possibility of future large eruptions, scientists from IPGG, Novosibirsk, have deployed the first temporary seismic network on the Gorely volcano. This network consisted of 21 uniformly distributed seismic stations that operated for one year from August 2013 to July 2014. Most of the time during the observation period, dozens to hundreds events per day and frequent tremors were recorded which indicated significant activity inside the volcano. As a result of preliminary processing, almost 300 events were identified during only several weeks of recording. The available distributions of events and stations enables fairly high resolution in the derived seismic velocity models, as demonstrated by a number of synthetic tests. A striking feature of the tomographic inversion is an average ratio of $Vp/Vs=1.53$, which is an exceptionally low compared to other volcanic areas. We propose that this low Vp/Vs ratio is a signature of high content of gases beneath the volcano. Higher values of Vp/Vs beneath the crater below ~2 km depth might indicate some presence of liquid water, which comes from deeper sources and is transformed to the steam at shallower levels due to the decompression. It appears that Gorely is a kind of a huge steam boiler covered with a solid cover consisting of previously erupted basaltic layers. The fumarole inside the crater plays the role of safety valve which prevents the accumulation of excessive pressure inside the "boiler" and reduces the risk of a large eruption.