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Application of long-base laser interferometer for monitoring volcano hazards (Elbrus volcano case study)

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The long-base wide-band laser interferometer with a measurable armlength of 75m, situated in Baksan valley (the North Caucasus, Russia), is used for monitoring crustal deformations. The optical scheme of the interferometer, installed in an underground tunnel, is the two passes (N=2) Michelson-type interferometer with unequal arms. The long-term monitoring strains of the Earth is provided in tree frequency bands: below 10 Hz (low frequency channel), in the bandwidth of 1 Hz around frequency of 30 Hz (seismic channel) and in the bandwidth of 0.5 Hz around frequency of 1.62 kHz (acoustic channel). Unique geodynamical features of the region, the proximity of the Elbrus volcanic edifice and existing long-term high-quality observed time series of deformations allow to study a wide class of geophysical phenomenae. Analysis of the seismic signals, exited by the large number of global earthquakes and recorded by the Baksan interferometer during several years, revealed a set of the local resonant modes, which can be associated with magmatic structures of the volcano. According to geological-geophysical multidisciplinary study, the Elbrus volcano is classified as a "class A" active volcano having the low-density zones, extended in the crust from the depth of 25-30 km up to the summit. These zones may be directly linked to upcoming from the asthenosphere melted material that accumulates in a shallow magmatic structures (reservoirs and conduits). Upon incidence of a broadband seismic signal, mentioned structures are responsible for generation of secondary seismic wave fields providing the information about properties and dynamics of volcanic inhomogeneties. The parameters of the observed resonant modes - periods, ranging from 40 s to 70 s, and Q-factors, spanning the values of 250-300, give the possibility to relate these res-

onant modes to the shallow magmatic chamber filled rather with the liquid-gas foams than with bubbly fluids. Slight temporal changes of the Q-factors (with the rate of approximately 5 per month) may certainly indicate changes of magma state, particularly, gas-volume fraction. Such an approach provides a window to volcanic dynamics and lays a foundation of the new “resonant” method for monitoring the preparation of volcano eruptions. This work is supported by the Russian Foundation for Basic Research under Grants No 03-05-96752 and No 04-05-64917.