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Deglaciation and volcanism connection: evidences from Kamchatka and mechanical modeling.

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In spite of the relatively small scale of the last glaciation (with maximum ca 18 kyrs BP) in Kamchatka [Barr and Solomina, 2013] glacial rebound induced stresses were strong enough to cause spike of the early Holocene volcanism [Pevzner, 2012]. We perform simple mechanical analysis of the deglaciation effect on volcanism and calculate stresses and surface deformation in 2D caused by the instant loading and unloading of the viscoelastic crust and upper mantle. As a first proxy for the magma propagation path s1 direction was used. In all cases loading and unloading follows the exponential relaxation (e.g., in respect surface deflection) law with time exponent (τ) close to the theoretically predicted [Turcotte and Schubert, 2002] relation: $\tau = 2\pi\eta/\rho g W$. This law predicts fast surface deformations rates in the range 3-10 cm/y (at the ice thickness 1000 m) for the first τ years. Depth of the significant deviatoric stress is proportional to the glacier width therefore continental scale glaciers interact with upper mantle while regional late Pleistocene glaciers in Kamchatka (up to 100-150 km semi-width) act to the astenospheric depth. Fast deglaciation produces lithostatic pressure drop at the magma generation level equivalent approximately to the doubling of the ascend rate of the mantle flow. This leads to the increase of the magma generation rate during several kyrs. Specific configurations of the load include a) almost uniform weight distribution representing an ice shield b) load with prescribed small gap in the middle corresponding to glaciation of the high mountain ridge with ice free summits. In the second case maximum probable thickness of the ice cover was calculated as a difference between parabolic law estimate proposed by I. Barr and relief height along representative profile through the central Kamchatka to the ocean. Such ice load distribution has a maximum near the foot of ridge. In the early Holocene under former glaciers s1 becomes subhorizontal facilitating magma accumulation in the lower crust and at Moho depth while magma outcome paths lead to the peak of the mountain ridge and to the glacier periphery. Adiabatic decompression melting is the most affected by deglaciation. In Kamchatka definite geochemical signatures of adiabatic decompression melting component can be distinguished in Kluchevskaya group of volcanoes (KGV) and in the Central ridge (CRK). As expected, Ozernovsky volcano in central position in CRK was activated in the Early Holocene 9300 cal BP (Pevzner, 2012). Recently high explosive activity of Plosky volcano (now dormant) located on the periphery of KGV in the period 11.650-10.200 cal BP was recognized (Ponomareva et al., 2013). Last glaciation cover of KGV was at least 80 km wide.

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Literature.

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