

MUD VOLCANIC MANIFESTATIONS IN THE MAXIMUM SHAKING AREAS OF STRONG EARTHQUAKES

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Since 1980 in the Soviet Union and since 1991 in Russia the author has performed field study, including trenching of seismic ruptures in the epicentral zones of the all actual strong and major earthquakes. The mapping of ruptures system and excavation of trenches across the rupture of Kum-Dagh, 1983, $M_s=5,9$ and Burun, 1984, $M_s=6,2$, earthquakes in Western Turkmenistan, Spitak disastrous earthquake in Armenia in 1988, Zaysan, 1990, $M_s=6,9$ earthquake in East Kazakhstan, $M_s=7,0$, Racha earthquake in Georgia, Neftegorsk, 1995, $M_s=7,6$ tragedy on Sakhalin island, in the Far East region of Russia has been carried out. In these areas the seismically triggered mud volcanoes, griffons and other marks of liquefaction were observed in the zones with maximum shaking. Trenching data show wide spreading of the liquefaction repeating effects in the same seismic source zones in the past, during all Holocene.

Field study in 2002 of strong prehistorical earthquake traces in vicinities of the Elbrus volcano (North Caucasus), in the Baksan, Upper Malka and Upper Kuban' river valleys allows revealing both the primary seismotectonic ruptures and gravitational-vibratory one. To the primary ruptures pertains an echelon system of the ancient seismic faults of meridian strike, complicating board and surface of small ($0.6 \times 1.4 \text{ km}^2$) flat graben-like depression on the northeastern declivity of the volcanic cone and adjacent area. Total extent of the seismic faults system exceeds 15 km, but length of separate breakups is up to 800-1000 m. Breaches are characterized by the normal fault and sinistral kinematics. Breaches on surfaces of the depression are accompanied by narrow single-line pockets anomalous thick paleosoil (thickness about 1 m while normal thickness of modern soil is of 5-15cm), containing in bottom and side debris of the rocks – kind of the colluvial wedge. To secondary seismic ruptures pertain multiple landslides of soft slope sediments, rock block-slides, discovered on declivities of the volcanic building everywhere as well as in valleys of large and small rivers, bodies of ancient rock falls and stone avalanches in valley of Baksan, Adyrsu, Yusengi rivers, neptunic dikes in sand lenses inside of the alluvial thickness, in lacustrine sand and in the volcanic mud steam deposit horizon. Volume of some rock fall formation reaches 15-17mln.m³. Several areas with the development of sequences of lacustrine sediment, on ancient alluvial terrace in valley of big rivers were discovered. The lakes, where these sediments were formed, had dammed origin and were formed as a result accumulation of river water behind natural dam constructed by the ancient rock falls. From results of radiocarbon dating four short periods of seismic activations are marked approximately 5500, 3800, 2300 and 300-400 years ago. Seismic ruptures of different kinds are distributed on wide territory as a whole corresponding to size an source zone of earthquake with magnitude about 7.0. So the recurrence interval of ancient earthquakes is 1500-1900 years. It is known, that recurrence interval of Elbrus volcanic eruption is about 1000-2000 years. There is no direct time correlation between strong seismic and volcanic events. Marks of the liquefaction (mainly neptunic dikes) appeared approximately 5500 and 2300 years ago and were correlated with time of strong seismic catastrophes. Seismic intensity in the epicentral area during these events was not less 9 (MSK-64).