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Earthquake lights and rupture processes.

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Numerous eyewitnesses reports on the so – called "earthquake lights" (Derr, 1973; Enriquez, 2003) and even occasional photographs did not give clear evidence on the mechanisms of these fascinating events, but generally it is assumed that they are of the electric origin. The most difficult problem in explaining the mechanism of earthquake lights is not the formation and separation of charges but their survival for seconds and tens of seconds in the highly conducting soil. Lockner et al. (1983) suggested that containment of charge near the fault plane is caused by energy release due to friction which leads to evaporation of water and decrease of conductivity. We have proposed an alternative mechanism (Nemtchinov and Losseva, 2003) –localization of charges, currents, electric and magnetic fields are caused by the skin-effect. The higher is the conductivity the smaller is thickness of the skin-layer, but of course for rather short duration of current generation impulse.

Basing on the developed physical – mathematical model and the relevant computer code the 3D numerical simulations with given "external" currents in the faults were conducted. Vertical and horizontal propagation of the rupture was analyzed. Motion of the rupture was assumed as a self-healing wrinkle-like pulse (Heaton, 1990; Ben-Zion, 2001). The sizes, shapes and direction of propagation of ruptures were taken from the seismic waves records (Kikuchi and Kanamori, 1996; Umeda et al., 1996; Katao et al., 1997). It was assumed that generation of current occurs by electrokinetic or triboelectric mechanisms. Results of numerical simulation agree with the hypothesis of magnetic-diffusion type propagation of the disturbances in the ground. The computed thickness of the zone with high fields is in accordance with the size of the intense luminosity zone observed in the Kobe earthquake, 1995 (Tsukuda, 1997). The simulations were conduced till the establishment of a quasistationary regime of propagation of the rupture and magnetic disturbance near its leading edge. The luminosity zone first appears above the epicenter and then propagates with the rupture horizontally.

The total duration of luminosity coincides with the total duration of rupture propagation. The results of simulations were compared with observational data on the electric and magnetic fields at the distance of about 100 km from the epicenter (Iyemori et al., 1997).