Mechanism of generating electric fields just before great earthquakes

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[Introduction] Since more than fifty years ago, it has been known that radio noise is observed before great earthquakes, and it has been said that the mechanism of generating the fields is not clear. But many precursors of S Hyogo Pref. Eq. (1995/01/17 M:7.2) are showing that the mechanism is explained, though it is qualitative.

About one week before S Hyogo Pref. Eq., the column of cloud was observed which extended vertically from the source region up in the sky, even though strong wind was blowing then. We consider the cloud was generated by the current between the surface and ionosphere along the track of cosmicray showers, according to the same principle as Wilson cloud chamber. This phenomenon happened, because the electric conductivity on the source became locally high, as the density of Radium (Ra) and Radon (Rn) increased in spring water and surface air on the source just before the earthquake.

Ra and Rn are generated by decay of Uranium (U), and U exists in crystal boundary. If micro-cracks run in the source region, U, Ra and Rn dissolve into pore water, and the pore water mixes in spring water. So the micro-cracks induce the current, that is accompanied by many precursors.

[Background] As the attached figure shows, water drops in cumulonimbus change into ice crystals in the area of -10 degs, but the surface remains water. There are positive holes and free electrons in the crystal, and positive holes do not move into the surface water, but free electrons move into the water. As a result, the surface water becomes charged negatively and the inside of the water positively. The crystals collide with each other, the negative water on the smaller crystals moves to the lager crystals, because the velocity change of smaller crystals is greater than the change of bigger ones. As a result, smaller crystals become positive, smaller, and are blown up by an ascending air current. The potential becomes up to about 30 MV at the cloud top of about 10 km high. The conductivity between the cloud top and the ionosphere is relatively high, so electrons and negative ions flow from the ionosphere into the cloud top, that makes the ionosphere positive. On the other hand, the larger crystals become negative, larger, and drop down on the surface. Negative ions on the surface flow into the ionosphere along the trace of cosmicray showers, like lightning zigzags along the trace, and the potential of the ionosphere balances with about 1 MV.

[Precursory Electric Fields] The current between the surface and the ionosphere is invisible, except St. Elmo's fire, because the conductivity in the lower atmosphere is relatively low. But when the density of Ra and Rn increases on the surface, then the conductivity increases locally, and as a result, the current increases, and the current density becomes high enough by Pinch Effect for the electromagnetic fields to be observable.

The distance between the surface and the lower ionosphere is about 100 km, so 1.5 kHz wave, whose half wave length of 100 km, will radiate, when discharge happens between them. So, we have observed 1.5 kHz pulses. The fields of 3 kHz and 12 kHz have also been observed to discriminate the precursory fields from lightning fields by the following relations,

E(1.5kHz) is stronger than E(3kHz), and E(3kHz) is stronger than E(12kHz)

where E(f kHz) is the received field intensity at f kHz.

The left side is not valid for near lightning fields, which are maximal in 3 - 10 kHz, and right side is not valid for far lightning fields, because ionospheric propagation loss is heavy in 1 - 3 kHz, i.e., the fields of lightning do not satisfy the above relations. One observed example is shown in S145 Kozo Takahashi et al.

The fields have wide bands, because the discharge has many passes, and the radiated waves are pulses.