Precursory phenomena study of M7.2 Hyogoken Nanbu earthquake for predicting earthquakes from space

T. Ondoh (Space Earth Environ. Lab.)

Space Earth Environment Laboratory (ondoh@mbp.ocn.ne.jp/81-4-2922-3378)

We study mutual relations among precursory phenomena in the ionosphere, atmosphere and underground water observed before the M7.2 Hyogo-ken Nanbu earthquake of January 17, 1995, and propose desirable observations for predicting great earthquakes. The upward tornado-type seismic cloud appeared over Nojima fault of Awaji island near the epicenter in the Akashi strait in the evening of January 9, 1995 when strong VLF and LF radio noises from lightening discharges were observed at Uji about 90 km northeast of the epicenter.. Anomalous radon ion increases of about 10 times the normal density were observed for 8 days before this earthquake at Okayama about 200 km west of the epicenter. Characteristic phase changes at terminator times of Omega 10.2 kHz waves passing 70 km north of the epicenter extended toward darker times by 1 hour from January 14 to 16, 1995 before the earthquake. The atmospheric radon concentration over Ashiya fault in Kobe and in an well of 17 m depth near a subsurface fault in Nishinomiya had gradually increased above the normal one since 2 months before the earthquake, increased rapidly in December 1994, attained a peak just before the earthquake onset, and suddenly decreased to the normal one in October 1994 after the earthquake. Since the radon is ionized in the radioactive decay process, the atmospheric radon ion density should enhance over the Kobe area in the radon increase period longer than the radon radioactive decay half life of 3.8 days. The one hour extension of terminator times of the Omega 10.2 kHz waves seems to be due to a lowering of D-layer wave reflection height. The rock grain size is reduced by rock microcracxks. The concentration of radon being soluble in ambient water increases as contact surface of rock grains with ambient water increases. Radon atoms in rocks released to ambient water increase around faults and fissures just before the earthquake onset. So, the seismic precursory process is favorable for increasing the radon concentration in the atmosphere and underground water, and also for the terrestrial gas emanation from the active faults. The anomalous foEs increases above 6 MHz were observed together with ELF radio noise increases in the daytime on January 15, 1995 at Shigaraki and Kokubunji of epicentral distances within 500 km that is about the same as those of the terrestrial gas emanations before great earthquakes (King, 1986). Since geomagnetic and solar disc conditions were very quiet all day on January 15, 1995 and the foEs in the Japanese winter is normally below 6 MHz, the anomalous foEs increases above 6 MHz are an ionospheric precursor of the Hyogo-ken Nanbu earthquake. The radon ions will be carried up to cold high altitudes of 6 ĺC

8 km by rapid air currents of 70 ÍC 80 m/s in the seismic cloud. This process causes the charge separation between positive charges in the topside cloud and negative charges in the bottom-side cloud. Strong electric fields are set up in the lower ionosphere by lightning discharges of charged seismic cloud to the ground. The thundercloud electric field above the air breakdown electric field at altitude of 100 km causes ambient electron heating and ionization of neutral particles in the lower ionosphere to produce the anomalous foEs increases observed on January 15, 1995. Consequently, remote sensing of atmospheric radon by satellite-borne spectrometers, and ground observation of radon concentration in the atmosphere and underground water, and atmospheric radon ion density are promising for predicting great earthquakes with M ÍR7. 0 as well as ground observation networks of ULF geomagnetic field and ELFč-LF radio noises.