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Radioxenon isotopes: created in an underground nuclear explosion - measured in a verification detector

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Besides many other fission products, several noble gas isotopes are produced during and shortly after the explosion of a nuclear fission device. If the explosion took place in the atmosphere, in shallow water or just underneath the earth's surface, these isotopes and all other fission and activation products will be inserted directly into the atmosphere, and travel with the prevailing winds governed by the local meteorological conditions. However, if the device was underground, only the noble gases might be pushed through cracks in the surrounding soil or rock into the atmosphere – while most other fission products remain in the cavity. During their atmospheric transport noble gases are not washed out because they do not attach to particles. They will therefore not deposit on the ground but keep on travelling and only dissolve due to radioactive decay and dilution.

To verify the Comprehensive Nuclear Test Ban Treaty (CTBT), the Provisional Technical Secretariat (PTS) of the CTBT Organisation (CTBTO) has set up the International Noble Gas Experiment (INGE) to develop systems that are capable of measuring the noble gas radioxenon isotopes ^{131m}Xe, ^{133m}Xe, ^{133}Xe and ^{135}Xe at ultra low levels (minimum detectable concentration of one mBq/m^3 for ^{133}Xe and in current practice nearly ten times lower).

In mid October 2006 one of the INGE stations detected pulses of ^{133}Xe that could not be explained by normal anthropogenic sources like nuclear power plants or production facilities for radiopharmaceuticals. In this paper results are reported from atmospheric transport modelling that shows where on the globe an unknown source could have been located. Assuming it was an underground nuclear explosion the relation between

observations and what could reasonably be expected to leak from such an event is also analyzed.