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1.3-P13. The ”Smoking Gun” and its Geological Control

Following production at depth by nuclear fission reactions or neutron activation, gases escape the nuclear cavity, partly filled with melted rocks. In variable hydrogeological and meteorological conditions, these gases have to migrate through heterogeneous rocks and soils before they could be detected at the surface by OSI operations or IMS stations. All these processes may hamper a “smoking gun” evidence of a violation of the CTBT. This contribution reviews processes and related models or experiments carried out to develop expertise on migration and detection of radioactive gases. In the near field, xenon isotopes are fractionated from their precursory iodine isotopes due to contrasted solubility and diffusion in melt. In the far field, gases are first transported due to cavity overpressure, then by two-phase thermal convection later overtaken by barometric pumping. Toward the surface, increasing porosity and fracture aperture decrease gas fluxes to the atmosphere, also hampered by water infiltration. Besides dilution by the atmosphere, natural and anthropogenic background in xenon isotopes or argon-37 further conceals the signal. Delay, dispersion, dilution and fractionation of gases and their isotopes must be quantified to determine to what extent the source term can be detected at the surface despite extensive interactions with the geosphere.

Primary author: PILI, Eric (Commissariat à l’énergie atomique et aux énergies alternatives (CEA))

Presenter: PILI, Eric (Commissariat à l’énergie atomique et aux énergies alternatives (CEA))

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