Preparing for Methane-Related Fire Risks Triggered by Large Earthquakes —Mitigation Strategies and Disaster Literacy for Metropolitan Tokyo

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This paper examines the risk of secondary disasters caused by gases of subsurface origin, a hazard that remains insufficiently addressed in current damage scenarios and disaster-prevention planning for a potential Tokyo metropolitan earthquake. We outline the current understanding of this risk and discuss key challenges from the perspective of disaster literacy.

Tokyo, despite being one of the world’s largest megacities, contains significant “invisible vulnerabilities” beneath its surface. The Tokyo Lowland is underlain by soft, organic-rich sediments formed in former marine and wetland environments, where microbial activity generates methane that accumulates at shallow depths. Deeper formations connected to the Minami-Kanto gas field further facilitate upward gas migration. Under strong seismic shaking, such gases may be released to the surface and cause fires or explosions.

The large fire that occurred in Wajima City following the 2024 Noto Peninsula earthquake illustrates this potential mechanism. In that case, methane dissolved in groundwater was likely released by shaking, migrated upward, and ignited after a time delay of about one hour. This delay reflects processes such as bubble formation, growth, temporary trapping, and eventual ascent, distinguishing these events from ordinary urban fires.

Because methane is colorless and odorless, hazardous conditions may develop unnoticed, producing time-lagged risks that challenge conventional disaster assumptions. Addressing this issue requires integrating subsurface gas hazards into hazard mapping, facility design, public communication, and interdisciplinary research. Recognizing and sharing knowledge of these invisible risks is essential for strengthening disaster literacy and enhancing the resilience of Tokyo against future large earthquakes.

Keywords: Methane hazards, Earthquake, Disaster literacy

