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Earthquake Precursor Measurements Employing a Network of Radon Sensors

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1 Introduction

- Radon (Rn) gas is released through the decay of uranium & changes in radon levels have been observed prior to earthquakes..
- Stress in deeper layers due to tectonic movements cause cracking, enabling radon to escape from the bedrock.
- Carrier gases like CO_2, CH_4, & others can transport radon to the surface, influencing radon concentration in groundwater.

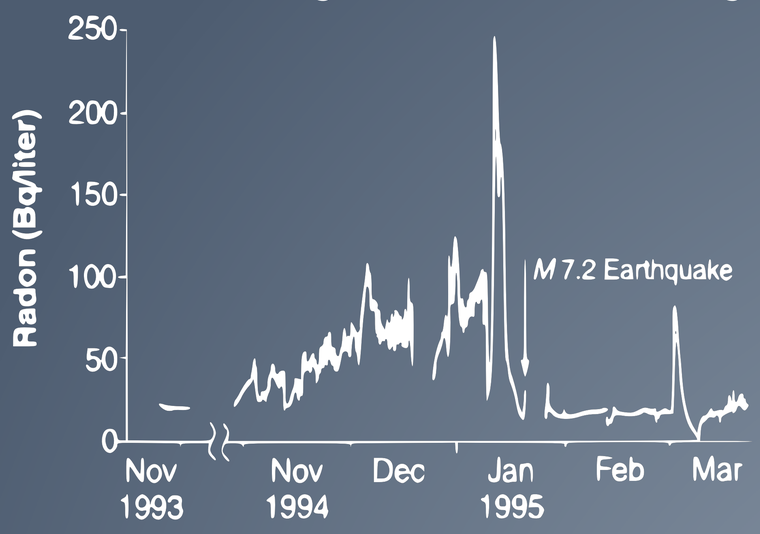


Fig.1: Rn activites in groundwater near 1995 Kobe earthquake(Igarashi et al., 1995)

Aim

- Create a dense network of Rn sensors in earthquake-prone areas.
- Develop AI tools that support correlation of earthquake events with sensor data.
- Measure Rn in ground water to reduce strong unrelated environmental fluctuations

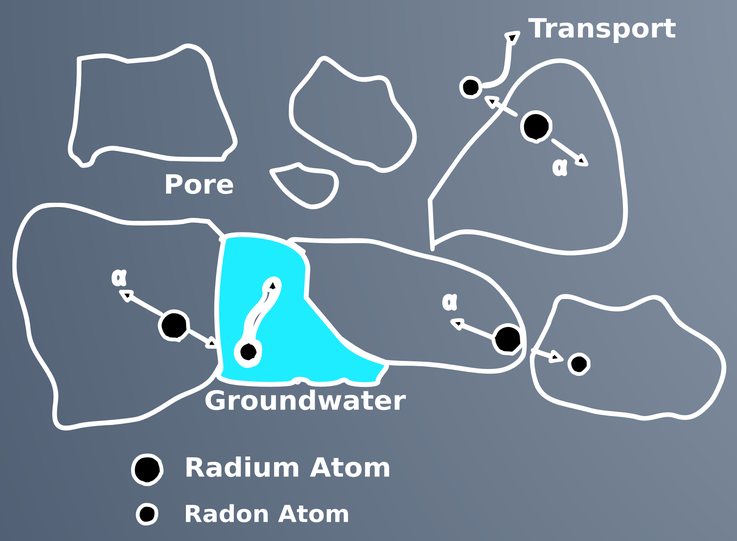
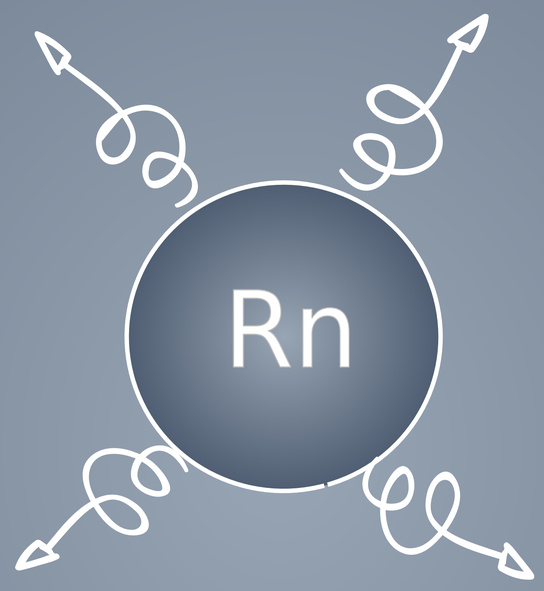


Fig:2 : Radon emission from the rock grains



2 Sensor design and Installations

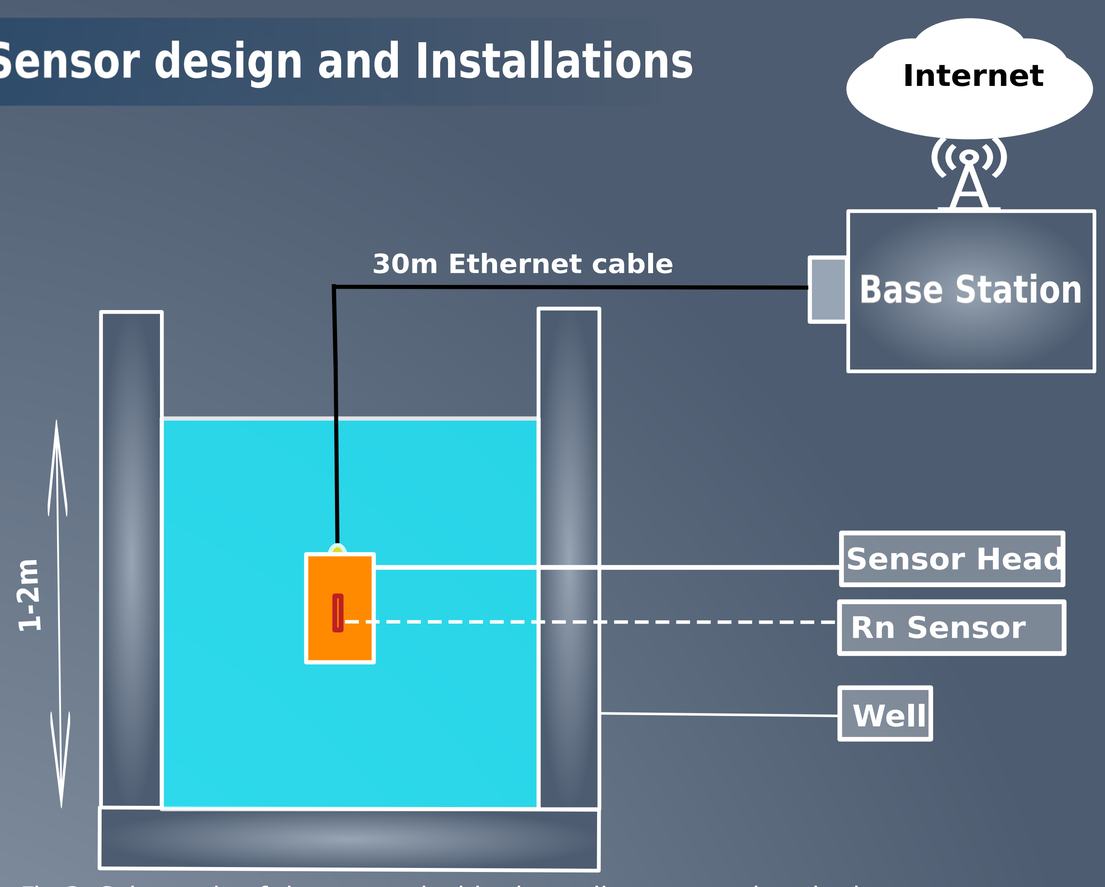


Fig.3: Schematic of the sensor inside the well, connected to the internet.

- The Protoype sensor head includes a γ-detector (CsI(Tl)), water pressure, conductivity, accelerometer, gyro, & PHT (Pressure, Humidity, Temperature) sensors.
- Sensors are installed at six locations near fault zones in Greece, Italy, and Switzerland.
- An in-house communication system is built to remotely read and store real time data.
- Rn daughters are identified via the γ-energies of 295, 352, 609, and 1120 keV.
- The sensor has an accuracy of 1 Bq/L, in a volume of approximately 1 m^3.

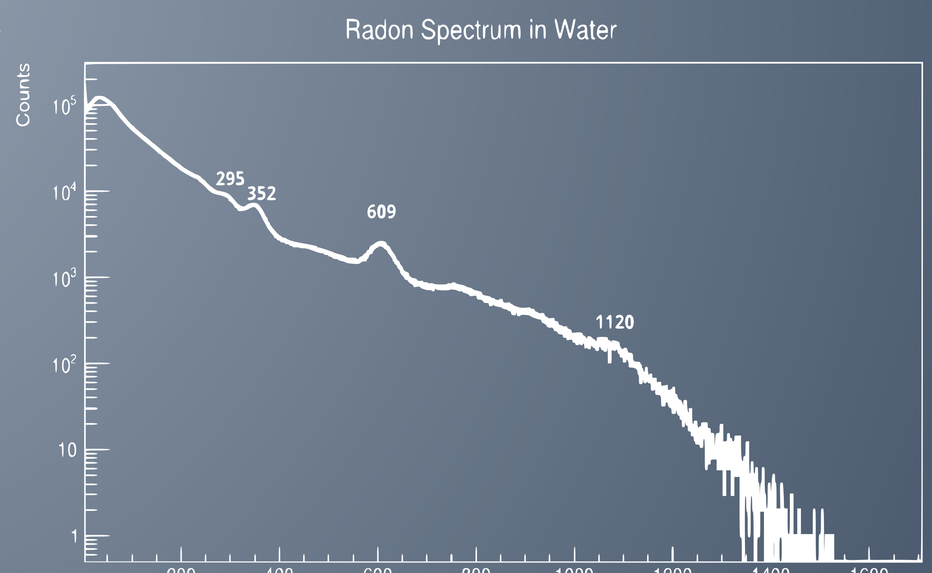


Fig.4: γ- spectrum taken at SURO, Prague with Rn activity of 297 Bq/L.

3 Results

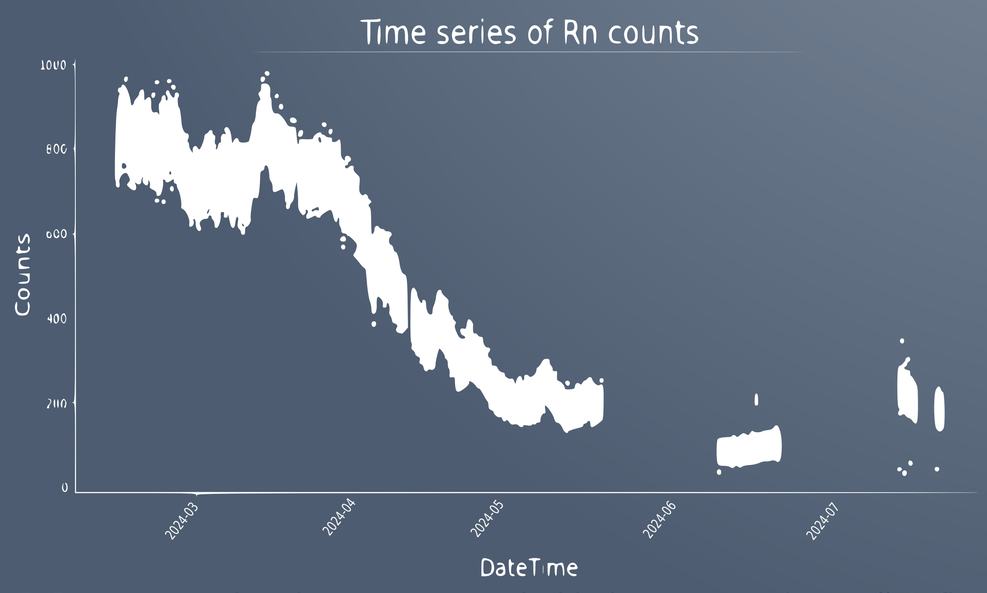


Fig.5: Rn concentration changes measured with the prototype in a well, Lefkada, Greece

4 Conclusion & Future

- Rn concentration in ground water is measured with highest sensitivity.
- Results from the prototype installations look promising
- An improved and simplified sensor has been developed with built in smartness and communication.
- ArtEms will install 50-100 sensors in selected region of Greece, Italy and Switzerland.
- Collected data will shed new light on changes of Rn concentration as an earthquake precursor.