

COSMIC MUON IMAGING OF HIDDEN SEISMIC FAULT ZONES: THE MEASUREMENT OF DENSITY VARIATION BY RAINFALL USING COSMIC-RAY

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Introduction

We have developed a novel radiographic imaging method to survey by measuring the rainfall permeation around the fault zone with cosmic-ray muon radiography and have radiographically imaged the fault zone up to 50 m below the surface.

General Instruction

We have developed a novel radiographic imaging method to survey the seismic fault hidden beneath the surface by measuring the rainfall permeation around the fault zone with cosmic-ray muon radiography. We performed measurements in Itoigawa–Shizuoka Tectonic Line (ISTL), Japan. When large amount of rain permeated gravitationally into the mechanical fractured zone around the fault gouge, the average density increases, hence, decreasing the number of muon events. The principle of the technique is that by measuring the time-dependent changes in muon absorption along different paths through the fault, one can image the permeable region in the interior of the object. A muon detector with an area of 3969 cm² and angular resolution of 100 mrad was located 6 m from the fault outcrop in UNESCO Itoigawa Geopark. In this work, we have radiographically imaged the fault zone up to 50 m below the surface. A systematic delay in response to the rain-fall events was observed with increasing depth only along the fault zone, which corresponds to the position and direction of the seismic fault estimated from the geometry of the fault outcrop. Applying the same method to another direction, we discovered a new permeable region that is parallel to the ISTL. This permeable region indicates a major seismic fault that is thought to be located along the ISTL.