

**Title:** A Comparison of Generalized Reciprocal Method and Seismic Refraction Tomography for Estimating the Subsurface Lateral Velocity Variation

**Abstract:** Seismic methods play an important role in subsurface exploration, offering valuable insights into the geological composition and structural dynamics of the Earth's crust. Exploring the fundamental principles underlying seismic propagation, we unravel the profound interplay between seismic waves and geological formations. SRT emerges as a formidable tool, in which refracted wave travel times can unveil high-resolution velocity variations in near-surface environments. In contrast, GRM extends its reach to deeper strata, leveraging reciprocal seismic data to illuminate subsurface velocity dynamics with remarkable depth penetration. Among the diverse array of seismic techniques available, Seismic Refraction Tomography (SRT) and Generalized Reciprocal Method (GRM) stand out as prominent tools for estimating subsurface lateral velocity variation. For seismic domain, it is necessary to have a foundational understanding of seismic methods, highlighting the principles governing the propagation of seismic waves through different geological medium. By examining the various types of seismic waves and their interactions with subsurface structures, we can gain insight into the complexities inherent in subsurface imaging and characterization. SRT utilizes the travel times of seismic waves refracted along subsurface interfaces to delineate velocity variations, offering high-resolution imaging capabilities suitable for near-surface applications. Conversely, GRM leverages reciprocal seismic data to estimate velocity variations across larger depths, making it well-suited for deeper exploration targets. By understanding the operational principles, methodological considerations, and practical applications of these techniques, we will be equipped with the knowledge and tools necessary to make informed decisions in subsurface exploration and geotechnical investigations.