

# **Determination of Electromagnetic Wave Velocity in Horizontally Layered Sedimentary Target: A Ground-Penetrating Radar Study from Silurian Limestones, Estonia**

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## **Abstract**

Ground-penetrating radar (GPR) is a non-destructive geophysical technique to obtain information about shallow subsurface by transmitting electromagnetic waves into the ground and registering signals reflected from objects or layers with different dielectric properties. The present GPR study was conducted in Võhmata limestone quarry in Estonia in order to describe the relationship between GPR responses to the variations in petrophysical properties. Sub-horizontally oriented cores for petrophysical measurements were drilled from the side wall of the quarry. The GPR profiles were run at the sloped trench floor and on the top of side wall in order to correlate traceable reflections with physical properties. Based on three techniques: (i) hyperbola fitting, (ii) wide angle reflection and refraction (WARR), and (iii) topographic, a mean electromagnetic wave velocity value of  $9.25 \text{ cm ns}^{-1}$  (corresponding to relative dielectric permittivity of 10.5) was found to describe the sequence and was used for time-to-depth conversion. Examination of radar images against petrophysical properties revealed that major reflections appear in levels where the changes in porosity occur.

**Key words:** ground-penetrating radar, electromagnetic wave velocity, petrophysical properties, limestone, Estonia.