Quantifying Nanoscale Porosity in Metamorphic Rocks: An Example from the Meguma Terrane, Nova Scotia

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ABSTRACT

In order to maximize recovery from oil and gas reservoirs, it is necessary to understand the porosity and permeability of the trapping formations. Metamorphic rocks are hydrocarbon traps and have low macroscale porosity, but nanoscale porosity exists at the boundaries between grains in rocks and may be an important mechanism by which oil and gas escape into the trapping formation. This study focuses on determining the porosity of metamorphic rocks from the Meguma Terrane, southeastern Nova Scotia over multiple mineralogical changes in a contact metamorphic zone. This study uses Small Angle Neutron Scattering (SANS) and Transmission Electron Microscopy (TEM) to quantify and image nanoscale porosity. The grains and voids will have different scattering intensities in SANS experiments, and thus the void volume and grain volume can be calculated, and from that amount of void space (porosity) can be determined for a bulk volume. Additionally, the average pore size can be calculated. TEM analysis will complement the SANS results by imaging grain boundaries and measuring nanoscale pore sizes. These methods will be applied to multiple metamorphic grades across a field gradient to determine how porosity changes in metamorphic rocks as a result of peak temperature and the associated mineralogy. Results from this study will serve as a baseline for understanding porosity changes over a metamorphic field gradient, and results of this study will be able to be applied by petroleum geologists to reservoir trapping formations to understand which grades of metamorphic rocks might be the tightest hydrocarbon trap.

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