TEXTURES OF CHERT AND NOVACULITE: AN EXPLORATION GUIDE

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ABSTRACT

Textures of chert and novaculite observable in scanning electron micrographs (SEMs) are useful as a practical, geologic thermometer for estimating the maximum temperature of those rocks during and since deposition. Such information may be further applied during exploration for hydrocarbons (maturation or degradation) and for metallic and nonmetallic minerals, in those and associated rocks.

Scanning electron micrographs of cherts and novaculites that crop out in the Ouachita Mountain fold belt of Arkansas and Oklahoma and in areas adjacent to exposed and buried intrusives show a sequential range in textures from cryptocrystalline, anhedral quartz in the nonmetamorphosed chert and novaculite to coarse euhedral, polygonal triple-point quartz 60 micrometers (μm) in diameter. A similar range of textures occurs in the chert of a contact metamorphic aureole on the Isle of Skye, Scotland, where classic metamorphic mineral suites from talc, through tremolite, diopside, and forsterite grades are represented. Hence, some of the chert and novaculite of the Ouachita Mountain fold belt shows textures that are morphologically correlative with classic representatives of varied metamorphic conditions.

Measurements were made of grain sizes of the quartz along transects across the SEMs of chert and novaculite from the Ouachita fold belt. From them an isopleth map was made showing mean grain sizes of the polygonal triple-point texture developed. The map defines a linear 25-65 km (15-40 miles) wide belt that extends from Little Rock, Arkansas, about 250 km (155 miles) west to Broken Bow, Oklahoma. The texture increases from the margins to the core of the Ouachita Mountain fold belt and contains two coarse-grain anomalies, one near Little Rock (35 μm diameter) and another near Broken Bow (15 μm diameter). This textural belt, with anomalies, conforms to the most intense, predominantly Late Paleozoic, structural deformation in the Ouachita Mountains. Previous interpretations have considered the rocks in the core of the fold belt to have attained a maximum metamorphic grade in the zeolite to lower green schist facies.

Cherts and novaculites adjacent to Magnet Cove, a Cretaceous age pluton in the eastern Ouachita Mountains of Arkansas, illustrate a superposed overprinting of polygonal triple-point texture. It ranges from a background of about 5 μm (talc grade) in chert 4500 meters from the pluton to about 45 μm (forsterite grade) from near the contact. Private drilling operations indicate that the pluton contact dips about 45° beneath much of the sedimentary rock that exhibits locally anomalous crystallinity. Homogenization temperatures of vein quartz determined by Herman Jackson and George Nichols (1973, personal communication) show a gradient along this profile of slightly above 200° C in quartz 4500 meters from the pluton to about 440° C near the contact. Novaculite xenoliths in the adjoining Potash Sulphur Springs intrusive are coarser in texture, 60 μm or larger, and represent the higher temperature periclase metamorphic grade, approx. 760° C at Crestmore, CA (Carpenter, 1967).

The triple-point texture and coarseness of chert and novaculite are related to the degree of thermal maturation brought about by various heating events. The crystal morphology is equivalent in the two processes described (regional and contact metamorphism) but the changes due to individual agents, temperature, physical deformation, time, depth of burial, and mineralizers have not yet been separately resolved.

By using SEM techniques very small quantities of chert and novaculite can serve as a guide to areas that have undergone elevated rock temperatures resulting from deep burial, mechanical stresses, intrusions, exhalations, and other thermal events. These investigations are relevant in determining temperature levels that may mature or degrade hydrocarbons, and offer clues in exploration for thermally related metallic and nonmetallic minerals. SEM studies of cherts and novaculite now provide another method of ascertaining the thermal maturation of rocks.

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