SIGNIFICANCE OF FRAMEWORK DISSOLUTION IN INTERPRETING SANDSTONE PROVENANCE

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ABSTRACT

Dissolution of unstable framework grains such as feldspar and rock fragments (including chert) is common in sandstones worldwide. Such framework dissolution usually results in a depletion of unstable framework grains and a corresponding enrichment of quartz. Failure to recognize this diagenetic modification of composition of a sandstone will result in misinterpretation of its provenance. A proper evaluation of sandstone composition may be achieved by including the dissolved portion of a framework grain as a grain, rather than as porosity, while point counting. This should be useful in interpreting original composition of sandstones and their provenance.

INTRODUCTION

Types, recognition, magnitude, and general significance of secondary porosity in sandstone have been discussed elsewhere (Chepikov et al., 1961; Savkevich, 1969; Schmidt and McDonald, 1979a, 1979b; Shanmugam, 1983 and in press [a]). Secondary porosity plays an important role not only in improving reservoir quality but also in modifying original composition of sandstones by grain dissolution. Unfortunately, conventional techniques of point counting (Galehouse, 1971) recognize only existing framework grains, and they do not estimate the dissolved grains. Consequently, petrographers estimate sandstone composition that is modified by diagenetic processes such as dissolution and replacement. This “diagenetic composition” may be misleading in interpreting provenance which requires an understanding of sandstone composition at the time of deposition, i.e., “depositional composition.” The purpose of this paper is to emphasize the significance of framework dissolution in interpreting the original composition of sandstones and their provenance.

In Figure 1, a comprehensive set of twenty criteria is proposed for recognition of secondary porosity. In some cases, more than one criterion may be applicable. For example, dissolution of framework grains can develop corroded grains, remnant grains, remnant clay rims, and oversized pores.

EFFECTS OF GRAIN DISSOLUTION ON SANDSTONE COMPOSITION

Successful interpretation of provenance depends primarily on our ability to decipher original composition of sandstone based on framework grains. Quartz, feldspar, and rock fragments (including chert) are the three major types of framework grains used in classifying sandstones (Folk, 1968). Conventional techniques of point counting framework composition are accurate only for sandstones in which framework grains are unaffected by dissolution. In sandstones with dissolved grains, the following steps are suggested to account for the effects of dissolution:

1. Recognize secondary porosity caused by grain dissolution.
2. Include the dissolved portion of a framework grain as a grain, rather than as porosity, while point counting.

In sandstones with completely dissolved framework grains, it is difficult to establish grain composition. Some general inferences, however, may be made regarding dissolved constituents on the basis of the overall diagenetic history of a formation.

The effects of grain dissolution on sandstone composition are hypothetically illustrated in three diagenetic stages in Figure 2. In the first stage, prior to dissolution of framework grains, the sandstone has more chert than feldspar, and therefore it should be termed as a lithic sandstone. In the second stage, when most of the chert grains have been dissolved, the relative abundance of feldspar increases with respect to chert. The sandstone would now be classified as a feldspathic sandstone. In the third stage, when most chert and feldspar grains have been dissolved, the sandstone becomes enriched in quartz, and it would now be classified as a quartz sandstone.