Peristeritic plagioclase in North Sea hydrocarbon reservoir rocks: Implications for diagenesis, provenance and stratigraphic correlation

MARTIN R. LEE,1,* PAULINE THOMPSON,2 PHILIPP POEML,1 AND IAN PARSONS2

1Division of Earth Sciences, University of Glasgow, Lilybank Gardens, Glasgow G12 8QQ, U.K.
2Department of Geology and Geophysics, University of Edinburgh, West Mains Road, Edinburgh EH9 3JW, U.K.

ABSTRACT

Reservoir sandstones from well 30/16-7 in the Upper Jurassic Humber Group, UK North Sea, contain plagioclase feldspars with a range of chemical compositions, microtextures, and origins. The chemical composition of feldspar grains in samples from three different depths in the core ranges from ~0 to 18 mol% An. Two of the samples have a well-defined gap in the compositional range between ~An4 and ~An9. This gap reflects the absence of plagioclase feldspars with those compositions in the ultimate source area of the Humber Group sandstones. Examination of An-bearing feldspars on either side of the gap by TEM shows that they have lamellar and/or tweed exsolution microtextures that are characteristic of plagioclase feldspars having bulk compositions within the peristerite miscibility gap. This is the first time that peristerites have been found in a sedimentary rock, and they suggest a low-grade metamorphic provenance for the plagioclase population. Compositional gaps have been commonly observed in Ab-rich plagioclase feldspars from metamorphic rocks, although the precise reasons why feldspars do not form within the gap remain poorly understood. In addition to the An-bearing peristerites, 30/16-7 contains a varied suite of An-poor feldspars. The microtexture of some of these grains is consistent with a low-grade metamorphic provenance, whereas others are inferred to be diagenetic in origin and to have formed by albitionization of detrital alkali or plagioclase feldspar. Stratigraphic differences in the presence and size of the compositional gap within the Humber Group suggests that plagioclase feldspars may be a powerful new tool for high-resolution stratigraphic correlation and may also be very sensitive indicators of changes in provenance.

INTRODUCTION

The micrometer- and sub-micrometer-scale microtextures of alkali and plagioclase feldspars in siliciclastic sedimentary rocks are the product of two processes: (1) exsolution, polymorphic transformation, and deuteric/hydrothermal alteration in their parent igneous or metamorphic rock; and (2) diagenetic alteration within the present or a former sedimentary rock. Diagenesis may include one or more episodes of dissolution, precipitation, and replacement of feldspar. If the products of these two processes can be distinguished reliably, feldspar microtextures may be a powerful source of information on both provenance and diagenetic histories.

The microtexture of some alkali feldspars can be observed by standard light microscopy or by scanning electron microscopy (SEM), but most feldspars have sub-micrometer-scale microtextures that are best studied by transmission electron microscopy (TEM). Previous work has shown how TEM can be used with great effect to determine the mechanisms of replacement of detrital alkali feldspar by authigenic microcline (Lee and Parsons 1998) and precipitation of adularia overgrowths (Worden and Rushton 1992; Lee and Parsons in press). Most of the recent work on plagioclase feldspars in siliciclastic rocks has focused on the evidence for diagenetic reactions, principally replacement of detrital alkali and plagio-

* E-mail: m.lee@geology.gla.ac.uk

0003-004X/03/0506–866$05.00 866