CRUDE OIL COMPOSITION AS AN INDICATOR OF SOURCE CHARACTER
AND MIGRATION/ACCUMULATION HISTORY:
AN EXAMPLE FROM THE PEARL RIVER MOUTH BASIN,
SOUTH CHINA SEA

C. R. Robison, L. W. Elrod
Texaco, Inc., 3901 Briarpark Drive, Houston, Texas 77042, U.S.A.

ABSTRACT

Compositional data from both bulk and detailed geochemical analyses were compared for crude oils from the Zhu 1 depression and the adjacent Dongsha Massif. This kind of study provides insights into source rock character and maturity in areas such as the Zhu 1 where samples of possible source rocks are not available. Additionally, such studies help explain crude oil distribution as well as some aspects of oil migration and alteration.

The results of the authors' work indicate that oils from the Zhu 1 and Dongsha Massif are very similar, despite some differences in their bulk properties. Unaltered oils are waxy while altered oils are naphthenic. All Zhu 1 oils are probably derived from lacustrine source rocks that contain not only algal organic matter, but also a considerable amount of higher plant debris. The data further suggest that, in some instances, the oils have experienced significant vertical and horizontal migration. In other cases, they appear to have undergone either thermal or biological alteration.

INTRODUCTION

Lying between the islands of Hainan in the southwest and Taiwan in the northeast, the Pearl River Mouth Basin (PRMB; Figure 1) covers an area of nearly 150,000 km² (60,000 mi²) of the South China continental margin (Zhai and Qiu, 1983). The PRMB is a Mesozoic/Cenozoic extensional basin containing three main subbasins or depressions: Zhu 1, Zhu 2, and Zhu 3 (Figure 1; Mercati and Zhang, 1988). Over the past 10 to 12 years, hydrocarbon exploration has been rather intense in the basin, especially in the Zhu 1 and on the Dongsha Massif immediately south of the Zhu 1. As a result of this activity, several significant oil fields have been discovered (Mercati and Zhang, 1988; Aquilera and others, 1990; Tyrell and Christian, 1990). Yet, the source of the oils remains unclear, as does their maturity, migration, and the type and extent of their alteration. Our purpose is to present the results of geochemical studies that permit us to clarify these aspects.

GEOLOGIC SETTING

According to Carnes and others (1990), the stratigraphic section in the southwestern part of the Zhu 1 consists of about 3500 m (11,550 ft) of synrift deposits and about 4800 m (15,840 ft) of postrift sediments (Figure 2). A typical sequence of continental deposits consisting of alluvial, flu­
vial, and lacustrine sandstones, shales, and coals comprise the synrift interval. The lowermost part of the postrift section consists of basal transgressive sandstones and limestones (Zhai and Qiu, 1983; Mercati and Zhang, 1988; Carnes and others, 1990). Near the Miocene-Oligocene boundary, a thick massive sandstone occurs. Overlying this is a transgressive sequence of carbonates, sandstones, and shales (Mercati and Zhang, 1988; Wang, 1990). Mercati and Zhang (1988) state that at the maximum extent of transgression, a carbonate bank formed over the Dongsha Massif and extended into the southern part of the Zhu 1 depression. The later Neogene section (middle Miocene and younger) in the central Zhu 1