Tectonics and Evolutionary History of the Cretaceous Intra-arc Yongdong Basin, Korea

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Abstract: The Yongdong basin developed during Early Cretaceous in the central part of the Korean Peninsula and bounded on the northwest and southeast by northeast trending mega-scale strike-slip Yongdong Fault. An 8 km thick succession of exclusively terrigenous sediments can be grouped into two mega-sequences. In concert with the migration of depocenter, the upper sequence overlaps the lower and occupies northern part of the basin during basin evolution. Alluvial and lacustrine environments were predominantly formed from early to late stage of the basin formation. Several lines of evidence support that the basin was formed within intra-arc tectonic environments and destroyed by polyphase tectonic force. Schematic evolutionary diagram of the basin is proposed.

Keywords: strike-slip tectonics, intra-arc, migration of depocenter

Introduction

Tectonic, magmatic and volcanic activities along the East Asian continental margin produced a series of sedimentary, igneous, and volcanic rock successions on the Korean Peninsula. Widespread occurrences of small Cretaceous sedimentary basins have been recorded along the northeast-southwest trending megafaults on the Korean Peninsula. Cretaceous sediments in Korea are exclusively non-marine origin with large amounts of volcanogenic material.

Since the mid-1980s, the origin of these basins has been studied from the viewpoint of strike-slip tectonics and various aspects of basin fill, such as basin geometry, subsidence history, climate, sediment source, drainage pattern, depositional mechanism, geological setting, and age. Stratigraphic and sedimentological characteristics of the Cretaceous basins on the Korean Peninsula are characterized by rapid vertical and lateral facies change over relatively short distance (Chang, 1977; Choi, 1986; Choi and Jin, 1988; Chun and Lee, 1991; Lee, 1990; Lee and Paik, 1989).

The Cretaceous Yongdong basin occupies an area of 480 km² and is developed between left-stepping en echelon sinistral strike-slip faults (Fig. 1). Yongdong basin deposits typically comprise more than 60% gravelstone with subordinate sandstone and siltstone. The gravelstone is either greenish gray or purple in color. Basin fills are divided into two mega-sequences by tectonic stage and sedimentological characteristics (Lee, 1990; Lee et al., 1991).

The lower mega-sequence is distributed mainly in the southern part of the basin, whereas the upper sequence in the northern part of the basin. The lower mega-sequence generally shows a simple fining-upward trend consisting mainly of disorganized and massive gravelstones. Disorganized breccias and gravels occur at the base of the lower mega-sequence. The sediments are overlain by black siltstone. Sediments of the lower mega-sequence are partly overlain by the sediments of the upper mega-sequence, and occupy a smaller area compared to the upper sequence.

The upper mega-sequence is composed of many cyclic fining-upward sequences. Paleocurrent directions, pebble composition and other sedimentological characteristics of the two sequences are different from each other (Lee and Paik, 1990). Major sedimentological characteristics of the two mega-sequences are summarized in Table 1.
Basement geometry of the Yongdong basin was interpreted as asymmetric half-graben by gravity and magnetic data (Kwon and Kim, 1994) and by sedimentological interpretation (Lee and Paik, 1989, 1990). Stratigraphic studies of the study area were carried out by Simamura (1927), Son et al. (1969), Kim (1973, 1974, 1996), Kim and Hwang (1986) and Lee et al. (1991). Lee et al. (1991) divided the Yongdong Group into Mangyeri, Saniri, Dongjongri, Sonyudong and Wonchonri formations in ascending order. In general, the lower mega-sequence comprises Mangyeri and Saniri formations, whereas the upper mega-sequence comprises Dongjongri, Sonyudong and Wonchonri formations.

Lee (1990) and Kim (1996) analyzed sedimentary facies of northern and southern area of the basin, respectively. In this paper, reconstruction of paleogeography of the Yongdong basin, interpretation on depositional environments based on sedimentary facies analysis, and discussion on tectonic affinity which produced sedimentary basin during Cretaceous in the Korean Peninsula were emphasized, and a evolutionary diagram of the Yongdong basin is proposed.

**Tectonic Setting**

Precambrian crystalline rocks commonly form the basement of Cretaceous sedimentary basins on the Korean Peninsula. The basement is gneissic rock which has been interpreted as the continental remnants of an allochthonous terrane accreted to the North China Block during Silurian to Devonian (Cruzel et al., 1990). During Mesozoic, there was a NE-SW trending large-scale right-handed ductile shear zone in the south-central Korean Peninsula (Yanai et al., 1985).

Korean Peninsula has been an active continental margin since Late Jurassic. At the end of the Jurassic, major fault movement took place along the Asian continental margin by collision of northward-moving South China Block and North China Block (Yin and Nie, 1993). After the indentation tectonics over the ancient Asian continent sedimentation and magmatic activities took place mainly by the subduction of the Kula plate, creating a large-scale sinistral strike-slip fault system. The system consists of three major sinistral strike-slip faults; the Sikhote-Alin fault system in Far East Russia (Utkin, 1975, 1984, 1993), the Tan-Lu fault system in China (Xu et al., 1987), and the Kongju and Yongdong fault system in Korean Peninsula (Lee, 1998). The system has close spatial and temporal relationships with geodynamic evolution and sedimentary basin formation along the border of the Asian continent (Lee, 1998; Utkin, 1993). During the Early Cretaceous, continued subduction of Kula plate/Pacific plate beneath the Asian continental margin yield northward compressional stress along the Asian continental margin (Cui et al., 1985; Hilde et al., 1977).

As a part of the Asian Terrane, the Korean Peninsula has not been subjected to any rotational movements since Cretaceous (Kim et al., 1990; Lee et al., 1987), but experienced subduction related magmatic activity and crustal deformation from the Early Cretaceous to Early Tertiary (Kim et al., 1991; Klimetz, 1983; Lee, 1994; Lee and Kim, 1990; Park et al., 1997; Watson et al., 1987).

The Early Cretaceous volcanic zone lies to the east of the deep-seated Tan-Lu fault and consists mainly of rhyolite, ignimbrite, tuff and other intermediate-acidic rocks (Chen, 1993). During middle to late Early

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**Table 1. Comparison of depositional characteristics between the two mega-sequences (after Lee, 1990)**

<table>
<thead>
<tr>
<th>Stage</th>
<th>Lower mega-sequence</th>
<th>Upper mega-sequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paleocurrents</td>
<td>NW, SE</td>
<td>NW, SE, NE</td>
</tr>
<tr>
<td>Depositional Environments</td>
<td>Alluvial Lacustrine</td>
<td>Alluvial Lacustrine Fluvial</td>
</tr>
<tr>
<td>Intrabasinal Clast</td>
<td>None</td>
<td>Exist</td>
</tr>
<tr>
<td>Location</td>
<td>Southern Part</td>
<td>Northern Part</td>
</tr>
<tr>
<td>Volcanic clast</td>
<td>None</td>
<td>Exist</td>
</tr>
</tbody>
</table>

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