광산지질 第4卷 第1號(1971), 大韓鑛山地質學會, p.39~43.
J. Kor. Inst. Mining Geol. v.4, n.1(1971), KIMG, p.39~43.

Recent Tectonism in the Korean Peninsula and Sea Floor Spreading

Byong Kwon Park* and Suh Woon Kim*

韓半島의 新期 地殼運動에 關하여

朴 炳 權·金 瑞 雲

Abstract

The Korean Peninsula is located between the tectonically stable Asian Continent and the tectonically active Japanese islands. The east coast of Korea shows evidence of uplift whereas the west coast shows evidence of submergence. Howeve, radiocarbon dates indicate that the rate of submergence of the west coast of Korea is slower than the tectonically stable east coast of North America. Therefore, both east and west coasts of Korea might have been uplifted during the last post-glacial period.

This uplift may result the spreading line of the from compressional strain produced along East Sea of Korea (Japan Sea) and/or the conversion hinge line of the Pacific mantle convection current plunging beneath the Asian continent. This downturn is supposed to be located in the Japan Trench. High heat flow near the east coast of Korea produces the differential strain. This strain accelerates the compressional strain of the peninsula.

The Sea Floor Spreading Theory can explain the tectonism of the Korean Peninsula in Recent time. Baek-Doo Mt. and Han-Ra Mt., dormant volcanoes, may be an evidence of westward movement of the Korean Peninsula.

Contents

* Department of Earth Science, Korean Military Academy

Introduction

The Korean Peninsula is located between the tectonically stable Asian continent and the tectonically active Japanese islands which are characterized by active volcanism and seismicity. The length of the peninsula is about 1,100 kilometers and its breadth is about 200 kilometers.

Despite its narrow breadth, the peninsula's east and west coasts exhibit strikingly different effects of epeirogenic movement. The mountainous east coast of Korea, Tae-Baek Mountains is structurally complex and shows evidence of uplift such as well-developed marine terraces and a simple shoreline. The west coast of Korea has low relief, is in a late maturity stage of the geomorphic cycle, and displays a Ria-type submergent shoreline (Fig. 1). The submergence of western Korea has been demonstrated by radiocarbon dating (Park, 1969).

The uplift of the east coast and submergence of the west coast of Korea are assumed to be tectonic origin.

Discussion

Sea level dropped by about 130 meters approximately 15,000 years ago, as demonstrated by radiocarbon dating in North America and Europe (Emery,1969, p. 114). After that time, sea level rose rather rapidly to within about five meters of the present level 5,000 years ago, after which sea level has risen slowly to the present level. Therefore, submerging shorelines are, in general, the result of rising sea level during the post-glacial period.

The submergence along the west coast of Korea has been 1.5 meter during last 4,000 years (Park, 1969, p. 63), while the submergence along the east coast of North America is generally has been 3 to 6 meters during the last 4,000 years except for Everglades in Florida where the submergence has been 1.7 meters (Bloom, 1967, p. 1477). Thus the rate of submergence along the west

Figure 1. Index map of the Korean Peninsula and Japanese Islands.
1. Baek-Doo Mt.
2. Tae-Baek Mts.
3. Han-Ra Mt.
4. Japan Trench.

coast of Korea has been slow relative to the tectonically stable east coast of North America. This indicates that the west coast of Korea may be, in reality, being uplifted at a relatively slower rate, and that apparent uplift and submergence of the east and west coasts of Korea respectively may result only from different rates of uplift.

The tectonism resulting in uplift of the Korean peninsula can be explained by the Sea Floor Spreading Theory. According to the theory, the Korean Peninsula is located near the hinge line where the Pacific Plate is subducted beneath the Japanese Islands (Fig. 2). The Japan Trench is supposed to be the hinge line, and intense volcanism and seismicity supposedly are related to the subduction of the lithosphere. The East Sea of Korea (Japan Sea) may be a rift just like the Gulf of California or the Red Sea to compensate the subducting of the Pacific Plate, and the Japanese Islands might have separated from the Korean Peninsula and drifted east-southeast (Murachi and Den, 1966; Uyeda and Vacquier,

1968, p. 353). Thus the Korean Peninsula is located within a field of compressional stress which resulted from the sea floor spreading along the East Sea of Korea and/or westward movement of a Pacific Plate mantle convection current (Pichon, 1968, p. 3661).

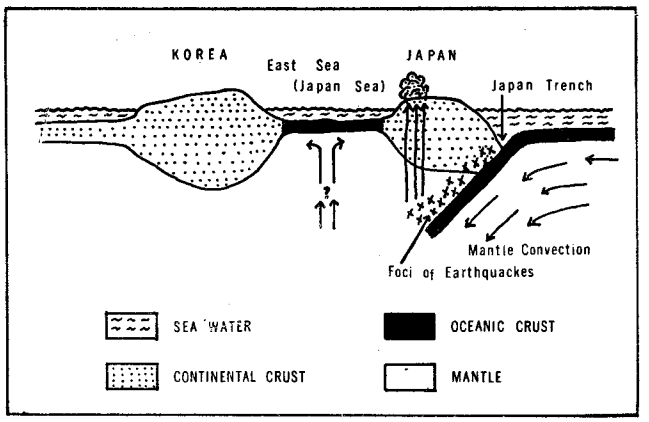

Figure 2. Sketch showing the mantle convection, distribution of volcano, and foci of earthquakes around the Korean Peninsula and Japanese Islands.

Uyeda and Vacquier (1968, p. 352) investigated heat flow near the East Sea of Korea and reported 2 to 3.01×10^{-6} h.f.u. for the eastcoast of Korea. These heat flow values are high relative to the average value of 1.5×10^{-6} h.f.u. in other areas in the world. Mizutani and others (1970) reported that the average heat flow in South Korea is 1.5×10^{-6}h.f.u. However, this average value is high relative to the average value for Precambrian shields. 0.92×10^{-6} h.f.u. (Lee and Uyeda, 1965). Since the Korean Peninsula consists largely of Precambrian rocks which are approximately 2,100 million years old (Hurley and others, 1970, p. 4). This peninsula, especially near the east coast, has abnormally high heat flow values. These high heat flow values may result from rising magma along the spreading line of the East Sea of Korea or from radioactivity, phase changes, shear strain, and adiabatic compression of subducting lithosphere (Minear and Toksoz, 1970, p. 1399).

The east coast of the peninsula should be heated and expanded because of high heat flow near the East Sea of Korea. The heat flow on the west side of the peninsula should be lower than that of the east side because the west is located farther from high heat flow area. Thus differential strain between the east and west sides of Korea is predictable from heat flow considerations. This differential strain in turn may produce the different degree of tectonism on the east and west sides of Korea.

Two dormant volcanoes, Baek-Doo Mountain and Han-Ra Mountain, are located in the northern and southern parts of Korea, respectively. One of them, Han-Ra Mountain, was active about 1,000 years ago (?) according to the records of Korea history.

Therefore, it is possible that these two dormant volcanoes were located closer to the subduction zone or the sea floor spreading line of the East Sea of Korea than at present. Many active volcanoes exist in the Japanese Islands near the hinge line. Thus dormant Korean volcanoes may be the evidence of westward movement of the Korean Peninsula in the course of sea floor spreading and continental drift.

There is, however, an argument against the westward movement of the Korean Peninsula due to the Pacific mantle convection current. If the Japan Trench is the Pacific Plate not an accreting margin (Dewey and Bird, 1970), then the Korean Peninsula and Japan should be a part of the Asian Continent. If it is a rigid plate, then the distance between Korea and Japan could not have increased. Therefore, the westward movement of the peninsula may be related to the sea floor spreading of the East Sea of Korea rather than the westward movement of the Pacific mantle convection current.

Conclusion

Sea floor spreading and continental drift are still theories; however, these theories are supported by much recent geophysical and geological evidence. The tectonism in the Korean Peninsula in Recent time can be explained by processes of sea floor spreading and continental drift, even though there is controversy over whether the Japanese Islands are at the Asian continental margin or whether the East Sea of Korea (Japan Sea) is a rift and the Japanese Islands have drifted away from the Asian Continent. The spreading hypothesis explains the slower rate of submergence of the Korean west coast, the uplift of the east coast, and the high heat flow values near the east coast of Korea.

要 約

韓半島는 地殼運動이 없이 安定한 狀態에 있는 아시아大陸과, 地殼運動이 活潑한 日本列島의 사이에 位置하고 있다. 韓半島는 比較的 좁은 東西幅을 가지고 있는데도 不拘하고, 東海岸은 隆起, 西海岸은 沈降現象을 보여 주고 있다. 그러나 西海岸의 沈降率을, 地殼運動이 거의 없이 安定한 狀態의 北美 東海岸의 沈降率과 比較해 보면 韓半島의 西海岸은 東海岸과 함께 徐徐히 隆起하되, 다만 示差的 隆起現象을 보이는 듯 하다. 이러한 隆起現象은 東海岸(日本海)을 따라 展開하는 現象이다. 太平洋 mantle convection이 日本海溝를 따라 아세아大陸으로 plunge 하는 데서 發生하는 壓縮應力에 基因하고 있을 것 같다. 또한 이러한 strain 은 東海 一帶의 높은 heat flow 에 依해서 加速될 것 같다. 이와 같이 近世 韓半島의 地殼運動을 海底擴張說(Sea Floor Spreading Theory)로서 說明할 수가 있으며, 休火山인 白頭山과 漢拏山을 韓半島가 西進한 證據로 看做할 수도 있다.

Bibliography

Bloom, A.L. (1967) Pleistocene shorelines: a new test of isostasy: Geol. Soc. America Bull., v.78, p. 1477-1494.

Dewey, J.F., and Bird, J.M. (1970) Mountain belts and the new global tectonics: Jour. Geophys. Res., v.75, p. 2625-2647.

Emery, K.O. (1969) The continental shelves: Scientific America, v. 221, no.3, p. 107-122.

Hurley, P.M., Lee, J.H., and Pinson, W.H. (1970) Radiometric dating of Precambrian rocks of Korea: Eighteen Annual Progress Report for 1970, M.I.T., Cambridge, Mass., p. 1-5.

Lee, W.H.K., and Uyeda, S. (1965) Review of heat flow data, p. 87-190, *in* Lee, W.H.K., editor, Terrestrial heat flow, Geophys. Monograph 8, American Geophysical Union, Washington, D. C.

Minear, J.M., and Toksoz, M.N. (1970) Thermal regime of a downgoing slab and new global tectonics: Jour. Geophys. Res., v.75, p. 1397-1420.

Mizutani, H.,Baba, K., Kobayashi, N., Chang, C.C., and Lee, C.H., and Kang,

Y.S. (1970) Heat flow in Korea: Tectophysics, v. 10, p. 183-203.

Murachi, S., and Den, N. (1966) On the origin of the Japan Sea: Read before February meeting of Earthquacke Res. Inst., Tokyo Univ.

Park, Y.A. (1969) Submergence of the Yellow Sea Coast of Korea and stratigraphy of the Sinpyeongcheon Marsh, Kimje, Korea: Jour. Geol. Soc. Korea, v.5, p. 57-66.

Pichon, X.L. (1968) Sea-floor spreading and continental drift: Jour. Geophys. Res., v.73, p. 3661-3697.

Uyeda, S.,and Vacquier, V. (1968) Geothermal and geomagnetic data in the around the Island Arc of Japan, p. 349-366, *in* Knopoff, L. *et al.*, editors, The crust and upper mantle of the Pacific area, Geophys. Monograph 12, American Geophysical Union, Washington, D.C.