This Week's Citation Classic

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Miyashiro A. Evolution of metamorphic belts. *J. Petrology* **2**:277-311, 1961.
[Geological Institute, Faculty of Science, University of Tokyo, Japan]

This paper showed that there exist three major types of regional metamorphism, and that different types represent different geothermal gradients. Regional metamorphic belts showing contrasting characters (i.e., high and low geothermal gradients) usually occur in pairs in circum – Pacific regions. [The *SCI*® indicates that this paper has been cited over 185 times since 1961.]

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"I began to work on metamorphic rocks of Japan at Tokyo University in 1947 under postwar difficulties. At that time, Alfred Harker's book, *Metamorphism,*[1] was very influential. It was claimed in this book that the regional metamorphism of the Barrovian sequence in Scotland is standard or 'normal' on a worldwide scale, and that minerals characteristic of such 'normal regional metamorphism' are stable only in the presence of strong shearing stress. However, such 'normal regional metamorphism' did not exist in Japan. Thus, my main problem was to clarify how and why the regional metamorphism of Japan differs from Harker's 'normal regional metamorphism.' I expected that I would be able to show the existence of a number of different types of regional metamorphism. I discussed it, for example, in relation to the compositional variation of metamorphic garnet in 1953.[2] Moreover, I doubted Harker's view emphasizing the necessity of shearing stress in the formation of certain metamorphic minerals. This motivated my proposal in 1949 of a hypothetical phase diagram of the Al_2SiO_5 minerals to explain their formation in terms of temperature and hydrostatic pressure only.[3]

"In the 1950s, a new improved system of graduate school was begun in Japan. I had many brilliant students (undergraduate and graduate) in metamorphic petrology such as F. Shido and S. Banno at Tokyo University in addition to my friend Dr. Y. Seki who was already a fullfledged metamorphic petrologist. Spontaneously we formed an active cooperative group. Banno and Seki studied a few glaucophaneschist terranes, and discovered that glaucophane forms only in a limited range of temperatures in progressive metamorphic sequences. This gave strong support to the existence of the glaucophane-schist facies.

"After several years of our cooperative study, I came to feel that we had already understood the main features of the two major types of regional metamorphism existing in Japan, and that these two types, together with one more type corresponding to Harker's 'normal regional metamorphism,' represent the three basic categories of regional metamorphism existing on Earth. I wrote this view in my 1961 paper. At that time, petrology had little connection to tectonics. The concept of paired metamorphic belts, described in this paper, was one of the earliest attempts to connect metamorphic petrology to tectonics.

"It is gratifying to know that the paper has been so frequently cited. It is a memorial to our metamorphic petrology group of the 1950s and the early 1960s in Tokyo."

1. **Harker A.** *Metamorphism.* London: Methuen, 1942. 300 p.
2. **Miyashiro A.** Calciumpoor garnet in relation to metamorphism. *Geochim. Cosmoch. Acta* **4**:179-208. 1953.
3. **Miyashiro A.** The stability relation of kyanite, sillimanite and andalusite, and the physical conditions of the metamorphic processes. *J. Geol. Sac. Japan* **55**:218-23, 1949.