Magma Type and Genesis of the Basic–ultrabasic Layered Intrusions in Panzhihua–Xichang Area, Southwest China

LU JIREN(卢纪仁), ZHANG GUANGDI(张光弟)
ZHANG CHENGXIN(张承信), GU GUANGXIAN(顾光先)
(Institute of Mineral Deposits, Chinese Academy of Geological Sciences, Beijing)
LIU YUSHU(刘玉书) AND HUANG YUNENG(黄与能)
(Geological Party 106, Bureau of Geology and Mineral Resources of Sichuan Province, Miyi, Sichuan)

Abstract

The layered intrusions in the Panzhihua–Xichang area may be grouped into two types: basic rock masses represented by the Panzhihua rockbody and basic–ultrabasic rock masses represented by the Hongge rockbody. Their major difference lies in that the former has poorly developed ultramafic facies, while the latter is characterized by well developed mafic facies and ultramafic facies. There exists apparent rhythmic stratification in the rock masses, which can be basically divided into four grades in terms of superimposition relationship and multicycle characters.

Both direct and indirect evidence suggest that the magma responsible for the layered intrusions in this area should be a transition-type alkaline olivine basalt magma derived directly from partial melting of the upper mantle. In rhythmic cycles of various grades, the magmatic evolution is characterized obviously by periodicity and early enrichment of Fe and Ti, which is evidently different from the evolution of the Skaergaard magma in which Fe and Ti are enriched at the late stage. The FCA diagram can be used to describe the unique evolutionary trend of magma in this area. It is demonstrated in this diagram that the enrichment of Fe and Ti is consistent with the increase of basicity.

In the upper magmatic chamber, the evolutionary trend of magma is conditioned by the difference in pressure, and this enables magma to form different types of rock assemblage. In the Fo–Di–An system, when the pressure exceeds $5 \times 10^5$ Pa, forsterite is incompatible with anorthite, and the rock facies sequence of Hongge type might form; when the pressure is lower than $5 \times 10^5$ Pa, forsterite can coexist with anorthite, and the rock facies sequence of Panzhihua type is likely to form if the magma is relatively rich in Mg and Fe components.

Two rock types, the basic rocks represented by the Panzhihua rockbody and the ultrabasic rocks represented by the Hongge rockbody, are recognizable in those well–known layered intrusions in the Panzhihua–Xichang area, southwest China. The genesis of the two rock types has excited a number of petrographic speculations, including (1) induced by faults that cut into separate magma chambers at different depths; (2) separate emplacements of ultramafic magma and gabbro magma; (3) separate emplacements of two magma fractions derived from a primary basaltic magma through differentiation at great depth; and (4) decomposed from a single large rockbody in response to tectonic activity. In their recent studies of the rift system in this area, some geologists hold that the layered intrusions, like some syenite bodies, may have generated from a melt derived from a highly alkaline basaltic magma through differentiation at depth. Detailed discussions on these problems are attempted in this paper based on some basic geological observations so as to stimulate further efforts in the direction toward the theoretical study of layered intrusions.
Basic Characteristics of the Layered Intrusions

There remains some controversy in regard to the geotectonic background of the layered intrusions in the Panzhihua–Xichang area. Traditionally, the intrusions were thought to occur in the Kangdian craton, controlled by SN–striking deep faults. But this idea has been challenged in recent years by some investigators who consider that this region was once an ancient rift in Late Paleozoic to Middle Mesozoic time and the layered intrusions resulting from upward bending of the mantle in the early stage of rift development[1]. The authors consider that the intrusions were emplaced in an environment of passive continental margin that had taken shape in Early Paleozoic time. Whatever it may be, however, the control of deep faults on the development of these intrusions seems to be acceptable beyond any doubt.

Also, no consensus has been reached concerning the time of emplacement of these intrusions. Some researchers hold that the intrusions were formed at approximately 350 Ma ago during early Hercynian[2]; others consider that they were formed after the Emeishan basalt at about 200 Ma ago; and still others suggest that they be a metamorphosed basement of Middle–Late Proterozoic age[3]. According to the authors, the intrusions seem most likely to have been formed during Late Caledonian at about 500 Ma ago, having nothing to do with the Late Paleozoic rift.

A zonal distribution pattern can be recognized in the S–N direction with respect to the layered

---

Fig. 1. Schematic geological map showing the distribution of layered basic–ultrabasic intrusions in the Panzhihua–Xichang area.