REE-bearing sector-zoned lawsonite in the Sanbagawa pelitic schists of the eastern Kii Peninsula, central Japan

TAKASHI UENO *

Department of Earth and Planetary Sciences, Graduate School of Science, Nagoya University, Chikusa-ku, Nagoya 464-8602, Japan

Abstract: Rare-earth elements (REE)-bearing sector-zoned lawsonite was found in Sanbagawa pelitic schists in the Ise area of the eastern Kii Peninsula, central Japan. The pelitic schists consist mainly of lawsonite, chlorite, phengite, titanite, albite, quartz, calcite and weakly-ordered graphite. Metamorphic conditions are estimated at P = 3-8 kbar and T < 350°C based on stability of the lawsonite-albite-quartz-calcite assemblage. Lawsonite occurs as prismatic and euhedral crystals (up to 500 µm long). Three sectors are well developed in the lawsonite grains. The {100} sector is more enriched in REE (La2O3 up to 0.55, Ce2O3 up to 1.18, and Nd2O3 up to 0.58 wt%) and depleted in Ca than the {010} and {001} sectors. The {001} sector is more enriched in Ti and depleted in Al than the {100} and {010} sectors. Compositional variations in lawsonite grains suggest [REE]AlCa1Si1 and [Ti]Al(Al, Fe3+)1Si1 substitutions. Lawsonite can preferentially concentrate REE, and constitutes a most important REE reservoir at high P-T metamorphic conditions, at which epidote group minerals are unstable.

Key-words: lawsonite, rare-earth elements (REE), sector zoning, Sanbagawa metamorphic belt, pelitic schist, Japan.

Introduction

Sector zoning is not infrequent in some rock-forming minerals, and enrichment of some minor elements in specific sectors has been reported; e.g., staurolite (Hollister, 1970), clinopyroxene (Nakamura, 1973; Leung, 1974; Shearer & Larsen, 1994), zoisite (Enami, 1977) and garnet (Shirahata & Hirajima, 1995). Compositionally sector-zoned lawsonite with rare-earth elements (REE up to 2.3 oxyde wt%) occurs in pelitic schists of the pumpellyite-actinolite facies in the Sanbagawa metamorphic belt. This paper (1) reports the mode of occurrence and the chemical characteristics of the sector-zoned lawsonite, (2) evaluates substitution relations of REE into lawsonite, and (3) points out the importance of lawsonite as REE reservoir in high P-T metamorphic rocks.

Mode of occurrence and petrography

Sector-zoned lawsonite was found in Sanbagawa pelitic schists in the Ise area of the eastern Kii Peninsula, central Japan (Fig. 1). The Sanbagawa metamorphic rocks in the Ise area are divided into northern and southern parts by lithologic characteristics. The northern part is mainly composed of pelitic schists with minor basic, siliceous and psammatic schists. In the southern part, massive metavolcanic rocks are widely dis-