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Chemical and spectroscopic characteristics of potassium white micas related to polystage evolution of the Central Western Carpathians orogenic wedge

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ABSTRACT

Potassium white micas in sheared basement and cover rocks from the Central Western Carpathians (CWC) were investigated by PL microscopy, electron microprobe (EMP) analysis, Mössbauer and micro-Raman spectroscopy. We specified chemical and spectroscopic characteristics, which allow distinction between celadonite-poor (muscovitic) and celadonite-rich (phengitic) white mica (Wmca). Wmca generations formed during a polystage evolution in changing *P–T* conditions ranging from the very low to medium temperatures at medium pressure within the Alpidic CWC orogenic wedge. BSE imaging, EMP analyses and X-ray element maps indicate chemical differences between muscovite and phengite, mainly in Al, Fe and Si contents. Mössbauer spectroscopy revealed their contrasting spectra, related to different hyperfine parameters, mainly of quadrupole splitting (QS of Ms: 2.6–2.7 mm/s, or 2.9–3.0 mm/s for Phg), corresponding to Fe^{2+} and Fe^{3+} contents. Blastomylonitic samples with a single dominating Wmca generation and finite-strain XZ sections were suitable for micro-Raman study. These data corroborate correlation between the frequencies of two vibrational modes of Wmca and Si content. The investigated Wmca generations indicate an enhanced transformation between Wmca phases in shear zones.

1. Introduction

The monographic work of Fleet (2003) yields a complete review on the chemical compositions and crystal structures of white mica (Wmca). Less information is available on crystal-chemical variations of natural K-Wmca phases. This is also reflected by scarce information on related Mössbauer (Bancroft, 1973; Rosenberg and Hooper, 1997; Yates and Rosenberg, 1997; Stevens et al., 1998; Collins and Rosenberg, 2004), micro-Raman (Nasdala et al., 2004) and X-ray diffraction (XRD) patterns (Frey et al., 1983). The implications of the variability of Wmcas in Alpine type shear zones for geothermobarometry and isotopic dating have, however, been well known since the classical studies of Frey et al. (1983), Frey (1986), Hunziker et al. (1986) or Massonne and Schreyer (1987). In this paper, we offer a complex methodical approach to the identification and characterization of different Wmca (Ms and/or Phg) generations by using present-day research methods such as PL microscopy, BSE imaging, electron microprobe analysis, X-ray element mapping, Mössbauer and micro-Raman spectroscopy. Wmca nomenclature is used according to Rieder et al. (1998) and Tischendorf et al. (2004).

Korikovsky et al. (1995, 1997a, b, 1998; Korikovsky and Putiš, 1999, and citations therein) studied crystal-chemical changes in authigenic and detrital K-micas in very low to low-temperature greenschist facies metasediments of the Central Western Carpathians (CWC). Wmcas in relationship to metamorphic mineral parageneses of greenschist, lower-temperature/medium-pressure amphibolite and eclogite facies of Cretaceous metamorphism were investigated in the CWC (Korikovsky et al., 1997b) and in the Lower and Middle Austroalpine complexes on the eastern margin of the Eastern Alps (Korikovsky et al., 1998; Putiš et al., 2000, 2002). The Wmca domains studied here comprise in part "celadonitized" muscovite from the burial stage and/or celadonite-rich muscovite–phengite that recrystallized to muscovite during the exhumation.

The main goal of this study is to document the correlation between chemical (EMP) changes of natural K-Wmcas and their typical Mössbauer and micro-Raman characteristics. These data should enhance identification of different natural K-Wmca phases by using these common analytical techniques. The results are mainly applicable to sheared rocks, usually containing more Wmca generations representative for different evolution stages of their burial and exhumation. We apply this study to an Alpidic-type orogenic wedge in the CWC, Slovakia.

Mineral abbreviations in text, tables and figures were recommended by Siivola and Schmid (2007): Ab—albite, Act—actinolite, Bt—

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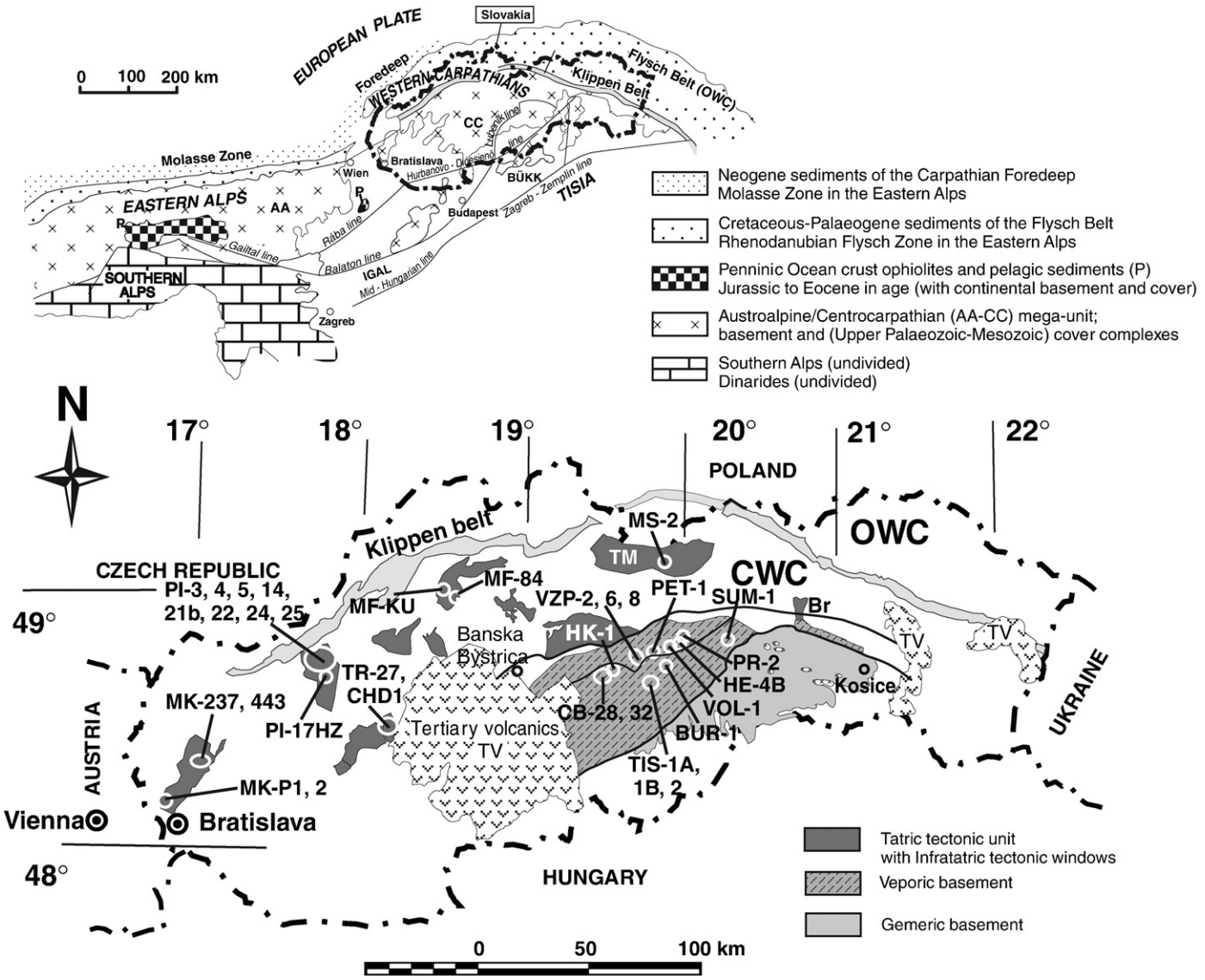

Fig. 1. Tectonic sketch-map of the mid-Cretaceous tectonic units (zones) in the Central Western Carpathians and sample locations. TM—Tatra Mountains, Br—Branisko Mountains.