

Formation age of Fengtien Nephrite, Taiwan: Dating low-temperature thin (<20 μm) zircon rims by NanoSIMS

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Nephrite in the Fengtien area is associated with serpentinites within the subduction-accretionary complex in eastern part of the Central Mountain Range, Taiwan. In addition to nephrite, there are also other metasomatic rocks, such as diopsidefels and epidotite, present between serpentinites and their country rocks (metapelites and metapsammites). Among these metasomatic rocks, diopsidefels is the most common one observed, while nephrite and epidotite are less frequently present in association with diopsidefels. When all these rocks are present at one outcrop, the common lithologic sequence is serpentinite-nephrite-diopsidefels-epidotite- metasedimentary rocks. Nephrite, diopsidefels and epidotite were interpreted resulting from fluid-rock (serpentinite+country rocks) interactions during subduction metamorphism. Field occurrence and petrographic observations clearly showed that while nephrite and diopsidefels are mainly metasomatic products after serpentinite, epidotite is after metapsammite. The formation temperature has been estimated to be 300 - 400 °C based on regional geology and thermodynamic calculations by previous studies. Timing of these metasomatic processes, however, has not been constrained, although the hosting subduction-accretionary complex was thought to be of late Cretaceous in age due to paleo-Pacific subduction beneath the Eurasia continent and to be correlated with the Sambagawa belt in Japan. Zircons were separated from one epidotite sample in this study. Most of these detrital zircons were shown to have a thin zircon rim, which is less than 15 - 20 μm in thickness. These zircon rims were considered to be newly formed during metasomatic interactions between serpentinite and country rocks, which also led to nephrite/diopsidefels/epidotite formation. The CAMECA NanoSIMS NS50 at AORI, the University of Tokyo was employed to date these low-temperature thin zircon rims with a ~ 5 nA O⁻ primary beam confined to a ~ 15 μm diameter. Sample surface was pre-ablated for 5 minutes to remove the surface Au coating and any possible surface contaminants. Data acquisition time was 500 seconds. The resulting $^{238}\text{U}/^{206}\text{Pb}$ - $^{204}\text{Pb}/^{206}\text{Pb}$ inverse isochron gave a young age of 3.3 ± 1.7 Ma (MSWD = 2.1, n = 5). The date clearly showed that the Fengtien nephrite would have formed during the (initial) exhumation of the subduction-accretionary complex, which should be of late Cenozoic in age related to subduction of the South China Sea plate beneath the Luzon arc. The present study gave a good example that NanoSIMS is able to date zircon rims with a thickness about 15 μm formed under low temperature conditions only a few million years ago. The instrument has a great potential in future studies dating various low-temperature hydrothermal, metasomatic or metamorphic zircon overgrowths.

Keywords: NanoSIMS, zircon, U-Pb dating, Nephrite, Central Mountain Range, Taiwan