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The Genesis of Nephrite— Geochemical Constraints by B isotopes, Sr isotopes and Trace Elements

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Nephrite had long been mined as resources of gemstone in eastern Taiwan. It outcrops in the orogenic mountain, the Central Range, where the black schist dominates and the ultramafic serpentinites distribute sparsely. The orogeny has occurred when the subduction (South China Sea subducted to the Philippine Sea Plate) ceased and collision began at about 5 Ma. Observations shows the nephrite occurred at the interface of serpentinite and the Clinozoisite schist, enriched in Cr, Ni, but also Ca. The genesis of nephrite had been thought as a result of a series of complex reactions include the metasomatism of ultramafic rock and its surroundings and succeeding fluid interactions. This study conducts B isotopes, Sr isotopes and trace elemental measurement to give further geochemical constraints on the genesis of nephrite. Samples include rocks--black schist, clinozoisite schist, serpentinite, and associated minerals—nephrite, diopside, calcite, tremolite asbestos, cat's eye nephrite and talc. The Sr element are enriched in clinozoisite schist, calcite, black schist (1005 ppm, 285 ppm~545 ppm, 150 ppm, respectively), and rather depleted in nephrite, diopside, cat's eye nephrite, tremolite asbestos, serpentinite (4.3 ppm, 5.6 ppm, 3.2 ppm, 2.5 ppm, 2.0 ppm, respectively). Despite the huge difference in Sr contents, the $^{87}Sr/^{86}Sr$ ratios of all the samples are in the range of 0.71424 ~ 0.71815, with the highest in serpentinite (0.718151) and lowest in clinozoisite schist, nephrite and clacite (0.714240, 0.714788, 0.714951~ 0.715925, respectively), indicate the Sr source from continental crust majorly. The B concentrations and $\delta^{11}B$ values are: in serpentinite ~21 ppm and -0.5 ‰, in nephrite ~5 ppm and -6.1 ‰, in clinozoisite schist ~2.5 ppm and -5.9 ‰. The B isotopes characterize the serpentinite as of "subduction zone type". The isotopes study provides constraints to the genesis of nephrite and thus a possible viewpoint: although the immobile elements, e.g. Cr, Ni, shows the nephrites origin from serpentinite, its different $^{87}Sr/^{86}Sr$ ratios from serpentinite indicates later flushing by fluids which are similar to those in clinozoisite schist and calcite. And the nephrite's lower B concentrations and $\delta^{11}B$ values than in serpentinite may result from the flushing (replacement) of later fluids or dehydration processes, or both. Further discussions combining the viewpoints of mineralogy would be necessary to make more comprehensive interpretations.