# THE REACTION FORMING CORDIERITE FROM GARNET, THE KHTADA LAKE METAMORPHIC COMPLEX, BRITISH COLUMBIA: REPLY

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I am grateful to Tracy and Richardson for the opportunity to expand on the paragraph in question because their discussion emphasizes an important difference in possible interpretations of apparently similar data.

I was hampered, when I wrote my paper (Hollister 1977), by the absence of published data on garnet zoning where garnet is in contact with cordierite. I could only surmise from written statements (Richardson 1974, Thompson 1976) that Richardson's data were similar to mine. Now that Lasaga *et al.* (1977) have published a zoning profile for Mn, Ca, Fe and Mg, it is clear that my interpretation is not strictly applicable to Richardson's data. In this regard, I am in accord with Tracy's and Richardson's discussion.

However, Thompson (1976, p. 428) says that the zoning profiles in garnet adjacent to cordierite had been interpreted by Richardson to result from retrograde exchange of cations across a garnet–cordierite interface. This interpretation forms a basis for Thompson's choice of compositions of garnet (*e.g.*, core or rim) to be used in the calibration of the garnet–cordierite geothermometer/geobarometer. If Thompson's calibrations are applied to my data, I get contradictory and/or unrealistic pressures and/or temperatures. In other words, my interpretation of garnet zoning and Thompson's calibrations cannot both be right.

Tracy *et al.* (1976) present garnet zoning data for cases where garnet is in contact with biotite. Tracy and Richardson refer to these data in the context of a process of retrograde cation exchange (Hess 1971). However, an inconsistency in the data of Tracy *et al.* (1976) allows my genetic interpretation and that of Loomis (1975) to apply to their results. Table 3 of Tracy *et al.* (1976) lists data for the same sample as that illustrated in their Figure 5, referred to in the discussion of my paper. In the figure caption they state "Ca and Mn are virtually homogeneous, 3.2-3.7 and 2.3-2.8 atomic percent, respectively". The spessartine percentages for the core and rim, as given in their table, however, are 2.2 and 3.0 percent, respectively, beyond the range stated in the figure caption. Furthermore, the amount of change from core to rim, 0.8%, is greater than the amount of change in my garnets. For example, sample S5B, Table 1 (Hollister 1977) changes from inside of rim to rim by 0.33% spessartine (from 0.67 to 1.00). Clearly, what is "virtually homogeneous" to Tracy *et al.* (1976) could be significant zoning to me.

The second problem in presentation of data relevant to this discussion regards the scale of zoning in the profile presented in Lasaga *et al.* (1977). The change of Ca in the example from my paper is from 6.6% grossular to 4.6% grossular, from inside rim to rim. In the paper by Lasaga *et al.* (1977), "representative" mineral compositions range from 3.8 to 4.3% grossular. Although not stated, this presumably represents rim as well as core analyses, because the analyses are reported as "representative". Almandine ranges from 75.5 to 77.1%. The grossular and almandine changes in my garnet range from 6.6 to 4.6 and from 73.3 to 79.8%, respectively. Thus, although the grossular content in the garnets of Lasaga *et al.* (1977) changes less than mine (0.5 *vs.* 3.0%), the change in their almandine content is also smaller (1.6 *vs.* 6.5%). By plotting Mn, Ca, Fe and Mg on the same scale, Lasaga *et al.* (1977) have obscured any possible zoning changes in Mn and Ca. It would thus appear that my conclusions are based on relatively larger compositional changes than those reported by Lasaga *et al.* (1977).

I am still trying to understand zoning in high grade garnets where in contact with cordierite. There are at least four possible answers. The first is that I have found the correct interpretation in the Khtada Lake garnets and it applies in principle to the Massachusetts examples; the second is that Richardson has found the correct interpretation and that it applies as well to my rocks; the third is that there are at least two interpretations for similar zoning in garnet at similar grades of metamorphism and in similar assemblages, but with different tectonic histories; the fourth is that there is an unrecognized process which applies to both localities. The third alternative would appear to be most favored by Tracy and Richardson. I consider the question too important to close myself off to alternatives.

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## THIRD M.A.C. SHORT COURSE: URANIUM DEPOSITS, THEIR MINERALOGY AND ORIGIN

The third Mineralogical Association of Canada short course, on Uranium Deposits, Their Mineralogy and Origin, will be held on October 27 to 29, 1978, following the joint meeting of the Geological Society of America, Geological Association of Canada and Mineralogical Association of Canada. Contributors will include R. T. Bell, R. DeVoto, S. S. Ghandi, J. Hoeve, H. D. Holland, S. Holmes, S. Kaiman, M. M. Kimberley, F. F. Langford, R. McMillan, R. D. Morton, J. Rimsaite, J. A. Robertson, V. Ruzicka, T. I.I. Sibbald, H. R. Steacy, N. Theis and J. Tilsley. The registration fee will be $250 for professionals, $150 for students; there is no registration form. A registration deposit of $50 should be made payable to:

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