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THE HYPOTHESIS OF VOLUME-CONSERVATIVE SYMPLECTITIZATION OF HIGH-PRESSURE PHASES DURING RETROGRESSION OF ECLOGITES: EXAMPLES AND IMPLICATIONS

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We found compelling microtextural evidence to hypothesize that, in a reference frame of inert markers, growth of symplectites at the expense of high-pressure phases of eclogites are volume-conservative reactions, as suggested by CARLSON & JOHNSON (1991). Since symplectites are less dense than the phases they replace, a first order prediction of the above-formulated hypothesis is that net export of substance should always accompany their growth. In order to estimate possible petrological implications, we calculated local mass balances of symplectitization of omphacite, kyanite and garnet from selected retrogressed eclogites from the South Carpathians of Romania and the Western Gneiss Region of Norway. In this contribution, we focus mainly on the breakdown of omphacite. Our case studies reveal that, unlike other models, isochoric breakdown of omphacite to jadeite-poor clinopyroxene–plagioclase symplectites does not require contribution of other reactants. During this process, variable amounts of excess Si, Na, Mg, Fe and Ca, and only trace amounts of Al may leave the reaction front, implying a release of substance equivalent of up to 10 - 11 wt% of the consumed omphacite. Our results explain why extensive breakdown of omphacite to clinopyroxene–plagioclase symplectites may occur even in the simplest bimineralic eclogites, in which garnet may remain largely unaltered. Isochoric breakdown of kyanite to spinel–plagioclase symplectites needs input of Ca, Mg, Fe and trace Na, and eliminates Si and Al. This process results a net loss of substance equivalent of up to 10 wt% of the replaced kyanite. The breakdown of garnet to amphibole–plagioclase symplectites requires input of Na and H, and releases Si, Fe, Mg, Al and trace amounts of Ca, implying a net weight loss of up to 20 – 23 %. The eclogites we studied do not show any evidence for complementary reactions able to consume the excess substance released during symplectitization. Therefore, we infer that in these cases excess substance had to be expelled either to local veins or to the host rocks of the eclogitic bodies. We estimate that the breakdown of omphacite exerts major control on the composition of substance released during isochoric retrogression of eclogites, and could be responsible for various reactions, like albitisation that affects some felsic rocks in contact with these eclogites. Emphasizing, that volume-conservative symplectitization is an allochemical non-equilibrium thermodynamic process (e.g. JOHNSON & CARLSON, 1990, ASHWORT & CHAMBERS, 2000), we warn against using implied phases in geothermobarometry.

References

ASHWORT, J.R.& CHAMBERS, A.D. (2000): J. Petrology, 41, 285-304.
CARLSON, W.D. & JOHNSON, C.D. (1991): Am. Mineral., 76, 756-772.
JOHNSON, C.D. & CARLSON, W.D. (1990): J. Met. Geol., 8, 697-717.