Contributions by M. J. O'Hara to the debate concerning magma generation in arcs

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In the late 1960s, Mike O'Hara published a couple of papers [1] [2] which *inter alia*, addressed the problem of identifying primary (directly mantle-derived) basalts, the significance of experimentally-discovered thermal divides in phase equilibria, and the failure of ubiquity and volumetric abundance of basalt types as qualifiers for primary status. Among many later seminal petrological contributions, these observations have all stood the test of time. Also in his 1965 paper, O'Hara pointed out the andesitic character of wet melting of peridotite at low (<1 GPa) pressures, and suggested oxidising conditions and crustal contamination were likely contributors to the development of the calc-alkali (*sic*) series, i.e., basalt-andesite-dacite-rhyolite. In 1968, he offered a pedagogically terse instruction in the abstract for the reader to pay attention given "figures and captions contain material and arguents not duplicated in the text", and examined 6 hypotheses for the origin of the arc-associated calc-alkali series: 1. Melting of sediments; 2. Assimilation of wet crust by dry tholeiitic basalt; 3. H2O-saturated melting of peridotite at low (<1 GPa) pressure; 4. Fractional crystallisation of high-alumina basalt under high PO_2; 5. Partial melting of dry eclogite; 6. Partial melting of basalt (pods/streaks) in the mantle. He noted that hypothesis (4) advocated by E. F. Osborn and co-workers "appears to suffer from the least objection in the present state of knowledge". There is general agreement now that arc magmas, at least in the low pressure range of development of the calc-alkali series, are oxidised compared with mid-ocean ridge and ocean island basalts. In addition however, there is evidence at least in some modern arcs, that partial melting of eclogite/garnet amphibolite in the formation of high-Mg andesite is important. Likewise, wet partial melting of refractory (harzburgitic) peridotite lithologies at relatively low pressures is known to be uniquely restricted to subduction zone settings. A significant role of amphibole fractionation in wet arc basalt for andesite generation was subsequently developed by Mike's PhD student, R. Grant Cawthorn [3], and a role for amphibole is now widely accepted for many arcs.

[1] O'Hara (1965) *Scot. J. Geology* **1**, 19-40. [2] O'Hara (1968] *Earth-Science Reviews* **4**, 69-133. [3] Cawthorn and O'Hara (1976) *Am. J. Sci.* **276**, 309-329.