A testable hypothesis for the origin of dry and aphyric high-Mg andesites

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High-Mg andesite (HMA) magmas in the Setouchi volcanic belt are likely to have been produced by slab-melting and subsequent melt-mantle interaction, followed by equilibration with mantle peridotites under hydrous conditions. However, several observations may not support the presence of a large amount of water in the erupted HMA magmas:

1) HMAs, although they are glassy, contain a small amount of H2O (less than 1wt.%);

2) HMAs are compact and are not vesicular;

3) HMAs are rather aphyric, generally having less than 10vol.% of phenocrysts.

It may be thus suggested that the ~5wt% of H2O originally present in a HMA magma would have been lost from the magma during intra-crustal processes. One possible mechanism that may account for the above observations is as follows:

1) a hydrous HMA magma solidifies within the crust through extensive crystallization under hydrous conditions;

2) only a limited amount of H2O can be kept in the HMA pluton in hydrous phases such as amphibole and biotite;

3) the HMA pluton is reheated by high-temperature basaltic magmas and melts partially;

4) effective separation of such partial melts and subsequent further melting result in the formation of a zoned magma reservoir with compositions ranging from dacite to HMA.

These processes may also reasonably explain the chemical compositions and petrographic signatures of composite lava flows, which often include HMAs in the Setouchi volcanic belt.