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Some Problems with Plate Tectonic Models and Arc Magmatism: Insights from Philippine Volcanic Data

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The spatial correlation between earthquakes, volcanoes, trenches and subduction has been a cornerstone of the plate tectonic paradigm. The Pacific Ring of Fire is a well-known example of the spatial concordance of volcano – subducting plate association. This may have led to to hypotheses linking direct slab melts as origin of arc magmas. While the current thinking is now dominated by the model that slabs only provide the fluids (and melted sediments) that lower the arc mantle solidus to provide melts to arc volcanoes, there are still contrarian hypotheses that suggest that slabs melt to form adakitic lavas. Volcanoes in the Philippine archipelago provide some testing for models attempting to explain controversial aspects of arc magmatism. First, there are unequivocally arc volcanoes, some of them active, that are not underlain by a slab. These volcanoes clearly cannot be generated by slab melting, but some of them display "adakitic" signatures. These volcanoes provide good evidence that "slab melt signatures" may yet be explained by alternative processes. Second, there are also arc volcanoes that have produced high Silica eruptives (dacites and rhyolites), which is surprising in an arc without a granitic basement. That the Philippines is mostly a diffuse tectonic boundary wherein the elements of frontal arc and back arc are difficult to define, but there are the "products" of arc magmatism suggest that fine-tuning may be needed with plate tectonic models linking directly arc volcanoes with subducting plates.