Preservation of Atypical Arc Rocks in Sutures

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Notwithstanding intensive study numerous questions remain regarding subduction zone processes: why, and how, does subduction initiate; how is material, in particular volatiles, cycled through subduction zones; how, and at what rate, is new continental material added to convergent margins; and what is the long term effect of subduction on the mantle. Addressing such questions by study of ancient rather than modern arcs has some advantages because in the former erosion has often exposed the deeper, usually inaccessible, parts of the subduction zone. Consequently, the compositions of a wide range of output products including extrusive and intrusive magmatic rocks, their associated mantle rocks, and metalliferous deposits can be determined. In addition, orogenic preservation permits spatial and temporal consideration of across and along arc inter-arc variations, and differences between arcs from the same ocean basin. Consideration of gabbros from the compositionally diverse Early Carboniferous mafic massifs preserved in the Palaeozoic Uralian arc-continent collision orogen, and comparisons of these with the products of well-characteristed modern arcs, permits us to: make inferences about fluxes through (Palaeozoic) subduction zones; draw conclusions regarding the plate movement and physical property controls on these; and assess their significance in terms of orogenic processes and palaeo-geodynamic evolution of the region. Most notable in the different Uralian mafic massifs is the association of slab-melt as the main subduction component in the massifs spatially closely associated with the main sutures of the orogen giving adakitic, isotopically depleted compositions. In contrast, massifs more distal from the sutures have more typical fluid-sediment addition subduction-related compositions. Elemental and isotopic analysis of Li and B is currently in progress to investigate and further define material fluxes. The adakitic compositions are indicative of atypical, anomalously warm, shallow angle subduction of relatively young ocean crust permitting melting of the slab, perhaps associated with slab-gap formation. We suggest, therefore, that generation and preservation of such compositionally diverse lithologies may be due to their production by atypical subduction associated with the Uralian Palaeozoic orogenic arc-continent collision.