Paired Metamorphic Belts Revisited

MICHAEL BROWN

Laboratory for Crustal Petrology, Department of Geology, University of Maryland, College Park, MD 20742, USA (mbrown@umd.edu)

Convergent plate margins are characterized by a duality of thermal environments, one representing the subduction zone and the other representing the arc–backarc or orogenic hinterland. This duality is the hallmark of one-sided subduction, and the imprint of this in the geological record the broadly contemporaneous occurrence of two contrasting types of metamorphic belt, one high d*T*/d*P* and the other low d*T*/d*P*. The broadly contemporaneous occurrence of granulite–UHT metamorphism with eclogite–HP granulite metamorphism in the geological record since the Neoarchean Era is evidence of dual thermal environments and indicates that subduction has operated on Earth since that time. Classic 'paired' metamorphic belts in which an inboard high d*T*/d*P* belt is juxtaposed against an outboard low d*T*/d*P* belt along a tectonic contact—such as the Ryoke and Sanbagawa belts in Japan—are found in Phanerozoic accretionary orogens of the circum-Pacific. Generally, they appear to result from juxtaposition of terranes with different metamorphic facies series that may or may not be exactly contemporaneous and that may or may not be far-traveled. This is an consequence of the difference between globally-continuous subduction, generating a low-to-intermediate d*T*/d*P* environment in the subduction zone and a high d*T*/d*P* environment in the arc–backarc system, and metamorphic imprints in the geological record that represent discrete 'events' due to changes in plate kinematics or subduction boundary dynamics, or that result from collision of ridges, arcs or continents with the upper plate at the trench. The concept of 'paired' metamorphic belts may be extended more widely than in the original proposition by Miyashiro to subduction-to-collision orogenic systems. Thus, the term may be used for "penecontemporaneous belts of contrasting type of metamorphism that record different apparent thermal gradients, one warmer and the other colder, juxtaposed by plate tectonics processes". This extends the original concept beyond the simple pairing of high d*T*/d*P* and low d*T*/d*P* metamorphic belts in circum-Pacific accretionary orogens, and makes it more useful in the context of our better understanding of the relationship between thermal regimes and tectonic settings. This is useful in subduction-to-collision orogenic systems, where the suture and lower plate materials will register the imprint of low-to-intermediate d*T*/d*P* and the upper plate will register penecontemporaneous high d*T*/d*P* metamorphism commonly manifested at shallow crustal levels by the occurrence of granites in the rock record.