Normal zircon and special zircon, and their functionality as geochronometers

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One of the very helpful characteristics of the mineral zircon in its function as a provider of petrological and geochemical information, especially as a geochronometer, is its generally high degree of predictability and coherence. Coherent zircon populations can be found in most magmatic and metamorphic rocks. In the simplest cases they consist of rapidly grown populations without xenocrysts and with controlled Pb loss behaviours. In more complex cases zircon may have grown stepwise over resolvable periods of time, it may have older inherited cores, and perhaps metamorphic overgrowths, and also be affected by subsequent Pb loss. Yet, even such zircon populations generally display recognizable and predicable morphological and compositional features which permit to address the various stages of development of the crystal. Geochemical analyses can then be performed on specific domains of crystals, evaluating their composition and using repeated analyses to test the consistency of the information. The exception to this rule is the 'special' zircon, the morphology and texture of which do not correspond to the common schemes and cannot reliably be used to extract and interpret information. Classical examples can be found in high grade rocks where prolonged and multiple events of crystallization and recrystallization can create rather chaotic zircon. In such crystals the relationships between morphology, textures and chemical and isotopic compositions are difficult to interpret and unravel. Similar incoherence can also be introduced in zircon by low grade geological processes, which often take advantage of advanced stages of metamictization using fluids and moderate heat to affect the structure of the crystals and redistribute, purge, or introduce in not always predictable ways various trace elements. Such secondary processes can also lead to wrong or problematic interpretations, for example by sealing in secondary mineral inclusions, or radically overprinting isotopic signatures. Other occurrences of 'special zircon' can be produced by uncommon processes such as shock metamorphism.