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Singularity analysis of frequency density of isotop age data

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Frequency distribution (histogram) calculated on the basis of igneous and detrital zircon U-Pb ages has been commonly utilized to interpret the age (range) of magmatic events. The temporal properties of this type of data have also been integrated with other types of isotope data (e.g., neodymium, hafnium, and oxygen) to describe the high magmatic addition rate (MAR) caused by plate subduction. Major peaks are identified to determine pulses of high-volume magmatic flare-ups related to subduction. In this paper, power-law models are applied to analyze these age peaks. The strong singularities of these models indicate that magmatic flare ups might be related to nonlinear phenomena of plate subduction including but being not limited to phase transition, self-organized criticality and multiplicative cascade processes. The case studies chosen for methodology validation include an igneous zircon U-Pb datasets from Gangdese arc, a orogen related to the India-Asia collision and from the Coastal Batholith related to east pacific plate subduction. It was found that the age density around peaks ca 51-50 Ma in both datasets can be fitted by power-law functions with the age interval about 30 - 40 Myr. The positive singularities of the age peaks estimated by these power-law models suggest that these age peaks might be related to magmatic flare-ups caused by multiplicative cascade and self-organized criticality tectonic processes.