Distinguishing periods of crustal growth and recycling by U-Pb dating, Sr, Pb and Hf isotopes among the Eastern Cordilleran granitoids of South Peru

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The backbone of the Eastern Cordillera of south Peru is built of plutons that have previously been mapped as Permo-Triassic. They were related to an extensional event that generated continental basins at the surface, filled with the sediments of the Mitu Group.

The aim of this study is to decipher age trends among the granitoids and asses their contribution to crustal growth. U-Pb laser ablation ICPMS dating of zircons shows that the plutons of the north-west trending Cordillera de Carabaya are middle to upper Triassic in age, while the plutons in the Abancay deflection are older: Ordovician, Carboniferous and Permian. Triassic plutons continue in north-western direction to the south of the Abancay deflection.

Hf-isotope data show positive εHf (~+2 to +4) for the Paleozoic plutons indicating a mantle dominated source while the Triassic plutons have εHf around 0 to -4 indicating mixing of mantle and crustal sources.

The Triassic plutons match exactly the age of the sediments of the Mitu group. Therefore, we conclude that these granitoids formed via partial crustal anatexis associated with extension. The offset of the plutons around the Abancay deflection could be interpreted as a step over in the Mitu rift. The Ordovician, Carboniferous and Permian plutons coincide with times of known continental arc magmatism along the western Gondwana margin and were emplaced in a back-arc setting.

Hf-isotope results for both tectonic settings indicate variable amounts of juvenile input from the mantle and/or from a lower crustal source, reflecting an increasing importance of a crustal component in the Triassic. However, with the present data we cannot quantify crustal growth versus crustal recycling yet.

Historical perspective of passive aerosol remote sensing: Bridging the years

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For nearly three decades space sensors designed for other purposes were used to observe, quantify and characterize atmospheric aerosols. During this 'heritage period', algorithm development focused on three primary methods. (1) Occultation methods that measure the extinction of solar radiation and provide vertical profiles of aerosol extinction through the stratosphere. (2) Dark target methods that use the brightening of the scene to infer aerosol loading. (3) UV methods that use the deviation of the observed signal from expected Rayleigh scattering values. Besides these three main methods applied to the SAM/SAGE, AVHRR and TOMS measurements, respectively, to produce long aerosol time series, other methods have been developed to make use of multiangle, polarization and geosynchronous capabilities. These satellite aerosol products applied to data collected in the 1980s and 1990s made way for the era of the modern sensors that began with the launch of Terra in late 1999. The modern sensors: MODIS, MISR, OMI etc., were designed with aerosol in mind, but specifically with the goal of providing information that would help reduce uncertainties in estimates of climate forcing. The quantitative information they provided was unexpectedly also used in other applications including air quality forecasting, public health studies, and long-range transport of dust and pollutants. Thus, the modern satellite data helps to bridge the scales, as well as the years.