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TECTONIC GEOMORPHOLOGY, DRAINAGE BASIN METRICS, AND ACTIVE MOUNTAIN FRONTS

ABSTRACT: FRANKEL K.L. & PAZZAGLIA F.J., *Tectonic geomorphology, drainage basin metrics, and active mountain fronts*. (IT ISSN 1724-4757, 2005).

We use the gradients of first order channels and the ratio betweendrainage basin planimetric area and volume (R_{VA}) as primary topographic measures capable of distinguishing the relative tectonic activity of mountainfronts in both extensional and compressional tectonic settings.
Here we report results from test cases on five mountain fronts with variable rates of rock uplift and deformational style in the western United States and Italy. Our study is guided by initial results obtained from two ranges in the southern Rocky Mountains, USA, Sierra Nacimiento and the Taos Range, that have departed on unique landscape developmental pathways related to the degree of tectonic activity on the range front fault. A frequency distribution of Taos Range and Sierra Nacimiento first order channel gradients is distinctly bimodal and the R_{VA} positively co-vary with tectonic activity for the Taos Range.
We are able to generally reproduce these results for the tectonically active range front faults of the Wasatch Range in Utah and the Black Range in Death Valley, California.
We also examined the relationship between R_{VA} and channel gradients for the foreland flank of the northern Apennines, Italy.
A similar, positive relationship between R_{VA} and channel gradient exists in this fold and thrust belt, however these data exhibit higher variance than those collected from the uplifted footwall blocks in the western United States. We attribute the higher variance to the effects of overall larger drainage basin size investigated and the considerable variability in rock-type. In general, R_{VA} among the studied mountain fronts can be interpreted primarily in terms of the tectonic setting, and secondarily in terms of specific variations in drainage basin shape controlled by local rock-type and climatic setting.
The R_{VA} is an effective metric in determining the relative tectonic activity of fault-bounded mountain fronts and escarpments. When combined the gradients of first-order streams, the R_{VA} can help determine the relative position of a catchment along a time-dependent drainage basin development curve.

KEY WORDS: Mountain fronts, Escarpments, Landscape metrics, Stream gradients, Landscape evolution.

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