Geol. Paläont. Mitt. Innsbruck, ISSN 0378–6870, Band 25, S. 1–242, 2001

TECTONIC CONTROL ON THE ARCHITECTURE OF SEDIMENTARY BASINS: BETWEEN SIMPLE MODELS AND REALITY

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Numerical models are often considered as having some kind of miraculous properties or, alternatively, to be of limited value. Little room seems to be present between these two extremes. There is also a tendency to think that, more complex models (both in terms of software and input parameters) are more reliable and provide better predictions than simple ones. For the same token, simple even merely semi-quantitative models are neglected and first-order features misinterpreted. These assumptions are not always correct.

In fact, simple models can provide very interesting and often neglected tools and predictions. More complex models become very useful only when the scientific question has been exhaustively understood and defined. These topics are discussed on the basis of two examples relevant to the Alpine setting

The first example concerns relations between geochronological data and rock exhumation in a contractional context. A simple qualitative model, constructed assuming stable isotherms, leads to the disturbing conclusion that most of the samples measured for geochronology will yield ages basically unrelated to the thrusting (or contractional) event under scrutiny. This is the truer the more unrealistic is the assumption of constant geotherm. Particularly tricky is the interpretation of ages from mylonites which formed above the closing temperature of a specific mineral system. The presence of fundamental problems in the interpretation of the ages reported in the literature is demonstrated by the apparent contradiction between the very precise ages produced on such rocks and the well known long-lived character of most crustal faults.

A sophisticated modeling, able to consider the relative rates of exhumation and thermal relaxation can provide indirectly a measure of the quantities looked for, namely the ages of thrusting and exhumation.

The second example is that of foredeep basins, which, according to the general knowledge are quite simple and "boring" systems. Similarly to what seen for exhumation, a first simple analysis provides interesting observations. Indeed, simple models provide quite stringent predictions on the internal geometry of foredeep basins. The main predictions are: a) a stratigraphic gap is observed at the base of the foredeep which should increase moving towards the bulge; b) the pinch-out position of basin fill formations should migrate towatds the bulge; c) deeper beds should display an increasing dip towards the mountain chain. Furthermore, assuming an elastic rheology, subsidence should be contemporaneous with thrusting.

It is surprising how often these predictions are not verified in nature. Examples are observed in the Po Plain, the foredeep of Southern Alps and Apennines) and in the Adriatic domain between Dinarides and Apennines. In all these cases the mechanics of the lithosphere plays a significant role in influencing the simple behaviors. Most important are softening processes which tend to

localize the deformation and, thereby prevent the migration of the system predicted by simple models.

A further, commonly observed, phenomenon is the increased coupling between upper and lower plate in the convergence zone and the consequent onset of lithospheric folding. This produces patterns very different than those of simple models. For instance, areas previously uplifted such as the orogen itself can experience subsidence and become (partly) covered by marine sediments These topics can be adequately described only with more developed numerical models, especially those able to include the mechanics of the system.

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