Application of Forward Modelling in Fold Thrust Belts - An Alpine Example

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Forward modelling is a useful tool for structural interpretation in various situations of high geological uncertainty. Particularly in contractional domains, where seismic is often of limited help in the crucial regions due to poor imaging of steeply dipping horizons and computerized restoration is of limited applicability, forward modelling helps outlining and testing structural scenarios. With forward modelling the deep sub-surface processes can be constrained allowing a connection to the better constrained surface/shallow structures.

Rather unusual is the application of forward modelling complementary to field mapping. Nevertheless it can be of great use to solve geological problems if interpretations have got stuck. The big advantage of forward modelling as a field mapping support is the possibility to re-test the modelling outcome directly by on-site investigations.

The Rofan Mountains in the Austrian Northern Calcareous Alps have been chosen as an adequate test site for this purpose. They are well suited as they (1) show a layercake stratigraphy in the sedimentary panel of interest; (2) display textbook fault bend fold structures; (3) allow an insight into their internal build along some kilometre long cliff sections; (4) still represent a tectonic problem with as yet no generally accepted structural model.

Most striking in the Rofan Mountains' structure is the partitioned deformation with a virtually undeformed lower level, a strongly shortened intermediate level with large-scale imbrication and an upper level with a thick basal breccia succession only displaying gentle folds. The manifest explanation of late syn- to post-tectonic sedimentation does not fit as there was no deformation that early.

Forward modelling was used to test the resulting geometries assuming decoupling at the basis and the top of the middle level. The method of choice was the fault bend fold workflow of Midland Valley's 2DMove structural modelling software. Both approaches the duplex zone and the intruding wedge model ended up with the identical geometry well reflecting the current situation. The choice between the two models can only be made by means of kinematic indicator analysis in the field checking evidence for either a roof thrust or a passive backthrust, respectively. For palaeogeographic reconstructions the two model result in more than 5 km difference of the upper level succession stressing the need of fine-tuning the models by additional precise fieldwork.