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AMS-related shortening recorded in redbeds from growth strata, Pyrenees

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The Anisotropy of Magnetic Susceptibility (AMS) of terrigenous rocks has been used for a number of years to decipher deformational histories in orogenic fronts and related basins. One of the most significant realizations is that AMS in sedimentary rocks can reveal tectonic shortening where other standard markers fail to do so, such as cleavage. Because the magnetic anisotropy is so sensitive to subtle grain preferred orientation, a vast number of studies have been carried out that document many examples where flat-lying, seemingly undeformed rocks are in fact strained. Yet, one of the long-standing questions is how early in the geologic history such tectonic imprint develops in terrigenous rocks. Syntectonic sediments offer a unique opportunity to address this issue. Growth strata are exceptional candidates for studying depositional and related deformational processes because they provide a sensitive record of the convolution of deformation and deposition. Along the northern boundary of the Ebro foreland basin (S Pyrenees), the footwall of the Vallfogona thrust exposes a spectacular regional-scale growth fault-propagation fold in the syntectonic Berga Conglomerate Group. Across the structure, bedding dips change from 70° overturned to upright and horizontal over a few kilometers of section. Our initial magnetostratigraphy correlated to the geomagnetic polarity time scale, led us to assign the Berga Conglomerate Group to Chrons C15–C12 (Late Eocene/Oligocene age), suggesting a mean sediment accumulation rate of 22 cm/kyr. Such deposition rate allows us to retrieve a rather detailed progression of magnetic ellipsoids through the syntectonic sequence in beds with changing dip angle.

We sampled a number of red siltstones and sandstones sites to document the changes on the AMS pattern through the growth strata. In addition to standard AMS measurements, we also calculate strain based on deformed burrows. AMS data reveal a rather persistent ESE-WNW trending magnetic lineation parallel to bedding strike, and dominantly oblate magnetic ellipsoids with an anisotropy degree typically lower than 6%. Principal axes of minimum susceptibility typically plunge to the N after bedding correction. These observations, combined with the spaced cleavage attitude at some localities, suggest an essentially N-S layer parallel shortening with a top to the N shearing component that was followed by the regional folding that produced the Busa syncline.