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Development of an arcuate fold-thrust belt as a result of basement configuration: An example from the Rocky Mountain Front Range, Montana

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The Sawtooth Range forms part of the Montana Disturbed Belt in the Front Ranges of the Rocky Mountains, along strike from the Alberta Syncline in the Canadian Rockies. The belt developed in the footwall to the Lewis Thrust during the Sevier orogeny and is similar in deformation style to the Canadian Foothills, with a series of stacked thrust sheets carrying Palaeozoic carbonates. The Sawtooth Range can be divided into an inner and outer deformed belt, separated by exposed fold structures in the overlying clastic sequence. Structures in the deformed belts plunge into the culmination of the NE-trending Scapegoat-Bannatyne trend, part of the Great Falls Tectonic Zone (GFTZ). Other mapped faults, including the Pendroy fault zone to the north, parallel this trend. A number of mechanisms have been proposed for the development of primary arcs in fold-thrust belts, including linkage of two thrust belts with different strikes, differential transport of segments of the belt, the geometry of the indentor, local plate heterogeneity and pre-existing basement configuration. Arcuate belts may also develop as a result of later bending of an initially straight orogen. In the Swift Dam area, part of the outer belt of the Sawtooth Range, the strike of the belt changes from 165 to 150. This apparent change in strike is accommodated by a sinistral lateral ramp in the Swift Dam Thrust. In addition, this outer belt becomes

broader to the north in the Swift Dam region. However, the outer belt becomes extremely narrow in the Teton Canyon region to the south, and the deformation front is characterised by an intercutaneous wedge structure, rather than the trailing-edge imbricate fan seen to the north. A similar imbricate fan structure is seen to the south, in the Sun River Canyon region, corresponding well to the classic model of a deformation belt governed by a dominant thrust sheet, after Boyer & Elliot. The Sawtooth Range can be described as an active-roof duplex in the footwall to the dominant Lewis thrust slab. Analysis of the transport directions of the thrust sheets in the Range implies that the inner arcuate belt is a secondary arc, but that the later, outer arcuate belt formed by divergent transport. This two-stage development model is strongly influenced by the basement configuration. The deformation front of the outer arc is governed by NNW-striking Proterozoic normal fault structures. The entire Sawtooth Range duplex is uplifted over an earlier, NE-trending basement structure (the GFTZ), forming a termination in the Lewis slab. The interaction of these two fault trends allows the development of a linear deformation front in the foreland Jurassic-Cretaceous sequence, but an arcuate belt in the Palaeozoic carbonate sheets. Thus, the width and style of the outer arcuate belt also varies along the strike of the belt.

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