CENOZOIC TECTONIC SEQUENCES AND BASIN EVOLUTION IN WESTERN MONTANA

ABSTRACT

Cenozoic sedimentary and volcanic basin-fills in western Montana can be packaged into sequences related to regional tectonic events. We use interpreted seismic, borehole, and gravimetric data, regional mapping, and dated age constraints on Cenozoic deposits, employing well-based stratigraphic columns, paleogeographic, and isotopic ages, to delineate sequences and to generate a more data-integrated paradigm for Cenozoic basin evolution. The ‘Eocene unconformity’ or Rocky Mountain erosion surface underlies the oldest sequence. This sequence, known as Cenozoic Sequence 1/Challis Sequence, ranges in age from ~50 to 44 Ma. It preserves a record of orogenic collapse and basin development related to metamorphic core complex formation in the Cordilleran hinterland and isotopic normal faulting in the foold and thrust foreland, as well as abundant arc-magnatism. The overlying sequence, Cenozoic Sequence 2/Lower Kittitas Sequence, spanning a time duration of ~38 to 30 Ma, documents a tectonic interval of extensional collapse that occurred throughout the entire Cordilleran range. Significantly, this sequence is bounded by the ~30 Ma unconformity which may be related to eustatic and/or climatic changes rather than to tectonic events. The ~22 to 21 Ma Cenozoic Sequence 3/Upper Kittitas Sequence is bounded at its top by the Heminfordian unconformity, which represents a hiatus from ~20 to 17 Ma. The Heminfordian unconformity marks the change from orogenic collapse to backarc spreading of the western ocean basins. The overlying sequence, Cenozoic Sequence 4/Lower Walpapi Sequence, ranges in age from ~16 to 4 Ma. This sequence records the development of an extensional basin controlled by eastern basin margin faults and associated listric normal faulting in the fold and thrust foreland, as well as eustatic and eolian events. The youngest sequence, Cenozoic Sequence 5/Upper Walpapi Sequence, ranges in age from ~4 to present. It preserves a record of the opening and spreading of the Pacific Ocean Basin. Additionally, Cenozoic sedimentary and volcanic basins in western Montana can be subdivided into sequence stratigraphic units, which can be related to tectonic events. These sequence stratigraphic units can be used to interpret the tectonic evolution of the region. This approach provides a framework for understanding the tectonic evolution of the western United States and can be applied to other regions with similar tectonic histories.

References


