ABSTRACT

Middle Eocene strata in the Topatopa Mountains, Ventura basin, California were deposited as five unconformity-bounded depositional sequences in a seismically active basin characterized by rapid, episodic subsidence. Analysis of stratigraphic geometries, detailed facies analyses in a sequence stratigraphic framework, and backstripping-derived subsidence rates indicate that tectonically induced differential subsidence caused migrations of the Topatopa depocenter approximately every 2 m.y.

Unusually abundant convolute laminations and a slumped interval may record the influence of earthquakes. The convolute laminations do not grade downward into ripple laminations and are not associated with dewatering dikes and pipes as would be expected if the laminations were formed by shear from an overlying current or by dewatering during rapid burial. Thus, formation during shock-induced liquefaction is more likely. Also, a 10- to 20-m-thick slumped interval in the uppermost Cozy Dell Formation underlies a sequence boundary interpreted as a surface across which depocenter migration took place. Association of this slumped interval with a tectonically formed surface is consistent with deposition in a seismically active environment.

Rapid, episodic subsidence with attending earthquakes is recorded in Holocene strata of the Humboldt basin, an analog to the Topatopa depocenter. Most likely, rapid, differential subsidence in the Topatopa depocenter was episodic and also associated with seismic events. In addition, a middle Tertiary slumped interval in the southernmost San Joaquin basin is attributed to a seismic event. Similar earthquake-related events are recorded by sedimentation patterns in the Tertiary Ventura basin and may be evident in the strata of other active-margin basins as well.

INTRODUCTION

Southern California is famous for earthquakes. Small tremors are common, and the region has experienced several large (seismic magnitude >6.0), very destructive earthquakes in just the last two-hundred years. These events are reminders that the modern California environment is seismically active. If the present bears a relation to the recent geologic past, it would be no surprise to discover Tertiary sedimentary sections in California which contain evidence of ancient environments that were also seismically active. One Tertiary section that may record a seismically active past is the middle Eocene section exposed in the Topatopa Mountains, a geologically complex region located on the northeastern margin of the Ventura basin (Fig. 1).

Today, the Ventura basin is tectonically active. The northern basin margin, which is represented by the Topatopa and Santa Ynez Mountains, is cut by several faults (Fig. 2). One of these faults, the San Cayetano thrust, underlies the Topatopa Mountains and separates the basin from the basin margin. This