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Change in tectonic force inferred from basin subsidence: implications for the origins of tectonic force in the Valencia Trough

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The rifting process is discussed primarily in regards to the rheological structure of the affected lithosphere prior to and/or during extension. However, it is also an indelible possibility that changes in the intensity of tectonic force is an important factor in controlling the evolution of the rifting process. However, very few studies have discussed rifting with respect to changes in the magnitude of tectonic force. The present study attempts to estimate a temporal change in tectonic force from observed tectonic subsidence history. Tectonic subsidence occurs as a result of the density change due to thermal expansion and/or contraction and the density redistribution due to crustal thinning. Since the factors that control tectonic subsidence are strongly related to the processes involved in lithospheric extension, the temporal evolution of tectonic subsidence must reflect the activity of tectonic force that drives the rifting process. Using a simple one-dimensional model, we investigate observed tectonic subsidence in the Valencia Trough, as one particular example of a back-arc basin. The lithosphere is assumed to consist of three layers: wet quartzite upper crust, anorthite lower crust and wet olivine mantle. The initial thickness of the entire crust is 30 km as observed in adjacent areas, in which the thickness of the upper crust is assumed to be a half of the entire crust. It is also assumed that the density of the upper and lower crust is 2800 and 2900 kg/m^3, respectively. The thickness of the thermal lithosphere is defined by the depth of the 1350 $^\circ$C isotherm. In the numerical model, the total strength of the lithosphere is always equal to the applied tectonic force, and the magnitude of tectonic

force at each time is evaluated in order to fit the observed tectonic subsidence. Changes in lithospheric strength by thermal diffusion and replacement of crust with mantle are taken into account. The thickness of the thermal lithosphere is strictly required to be $\sim$90 km in order to explain the stretching factors inferred from seismic reflection and refraction studies. This study also shows that the intensity of tectonic force in the Valencia Trough generally abates with time and disappears $\sim$ 15-20 My after the initiation of rifting. Such a gradually decaying force leads to a constant strain rate during the main phase of the rifting. The predicted change in tectonic force suggests an important implication for the origin of the driving forces of the Valencia Trough, in particular as discussed in relation to the slab roll-back mechanism of back-arc basin formation.