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Basin Migration: Lithospheric vs. Crustal Controls

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In this study we investigate why sedimentary basins in extensional settings sometimes migrate, and the locus of strain shifts laterally. We have tested two mechanisms for basin migration with numerical models. These are both lithosphere-scale processes, based on strength variations in the lithosphere that occur because of changing temperatures in the lithosphere during and after extension. The first case shows that basins may migrate during very slow extension of the lithosphere. When the lithosphere is extended with slow rates, temperatures actually decrease (instead of increase) during rifting. This results in an increase in lithospheric strength at the location of the first-formed basin, which will eventually become stronger than its surrounding lithosphere. With ongoing extension, the basin migrates. In the second case, we model two phases of lithosphere extension, separated by a long period of tectonic quiescence. During the first phase of extension a sedimentary basin is formed. The period of tectonic quiescence is characterized by cooling of this basin and strengthening of the lithosphere. During the second phase of extension, the locus of strain migrates toward surrounding lithosphere. Although these mechanisms are successful in causing basins to migrate, they predict a time frame and spatial distance of basin migration that are sometimes much larger than observed cases. We therefore focus on crustal controls as an alternative explanation. Analogue models are used to study crustal rheological constraints on basin migration. First results indicate that crustal scale processes may cause the basin to migrate at shorter time and space scales.