Geophysical Research Abstracts
Vol. 20, EGU2018-14224, 2018
EGU General Assembly 2018

Transfer faults development mechanism in rift basin—Numerical model for evolution of Penghu Basin

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The factors of transfer faults development between normal faults include width of transfer zone, basal inherited structures distribution, and variation in strain rate of the rifting, etc. Development and distribution of transfer faults affect morphology and evolutionary history of rift basin. However, details about the relationship concerning development sequence and interaction between transfer faults and main normal faults of rift basin have been less addressed. The aim of this study is to investigate how the transfer faults influence the evolution of a well studied Paleogene rift basin, the Penghu Basin, offshore western Taiwan with simulation using Particle Flow Code - 3D (PFC-3D).

The Penghu Basin is one of the Paleogene rift basins characterized by half-graben arranged in a dextral en echelon pattern. The structural characteristics are: (1) the basin is composed of three sub-basins, which are also linked in a dextral en echelon pattern; (2) NE-SW trending boundary faults of three sub-basins are curved where they are linked; and (3) E-W trending transfer faults are distributed between sub-basins and in the far side from the boundary faults. We built PFC-3D models that were composed of brittle layers overlying ductile layers, which simulate upper and lower crusts respectively. Extensional force was imposed only on one side of the layers and the other side was fixed. We built two models with different boundary conditions, MS-1, two offset rift axes without inherited structure and rifting independently, and MS-2, two offset rift axes with a E-W trending inherited fault zone.

MS-1 model shows that the transfer faults and main normal faults developed simultaneously. Transfer faults formed close to the side of model that extensional force was imposed while the boundary faults coalesced with each other in the others part close to the fixed side. MS-2 model shows that the through-going transfer faults developed before the boundary faults development and caused hard linkage between offset boundary faults.

In summary, if transfer faults were originated from inherited structures, the boundary faults would be cut off and linked by the transfer faults. If transfer faults and main normal faults developed simultaneously, the former would have short length without cutting through the basin. These results indicated that the inherited transfer faults would limit the development and distribution of main normal faults in the synrift stage. Such phenomena are not consistent with what we observed that the transfer faults did not disturb development of the main normal faults in the Penghu Basin. Therefore, we suggest that the transfer and main normal faults of the Penghu Basin developed simultaneously.