Magma at rifted margins: when, where and how much?

G. Manatschal¹, S. Tomasi¹, N. Kusznir², C. Zhang³, D. Sauter¹, P. Chao¹, M. Ulrich¹, P. Chenin¹

1) IPG-EOST, Université de Strasbourg, 1 rue Blessig, F-67084 Strasbourg, France
2) Department of Earth, Ocean and Ecological Sciences, University of Liverpool, Liverpool L693GP, UK
   E-mail
3) CAS Key Laboratory of Ocean and Marginal Sea Geology, South China Sea Institute of Oceanology, Guangzhou, China
Magma at rifted margins: first order observations

What controls riftting?

**Extension**
- mechanics/rheology
- crust/lithosphere

**Magmatism**
- petrology/chemistry
- asthenosphere

What controls magma production?

**Plumes**
thermal structure
(e.g. Coffin and Eldholm 1994)

**Stain rate**
(e.g. Lundin et al 2014)

**Inheritance**
melt entrapment
(e.g. Picazo et al. 2016)

What are the key parameters necessary to describe rifted margins?

OBSERVATIONS

- Extension mechanics/rheology crust/lithosphere
- Magmatism petrology/chemistry asthenosphere
Key parameters to describe magmatism in a rift system
magma budget vs. relative timing of magma formation as a function of extension
(Tomasi, Kusznir et al. in prep.)

Main questions:
• When does first magma form?
• Where does it form?
• How much magma is produced?

Legend:
- continental crust
- magmatic crust

(Tomasi, Kusznir et al. in prep.)
Main question:
- What is a “normal” rifted margin?

Magma forms when asthenospheric mantle reaches solidus
(after $\beta=2$ in depth-uniform model)

Full decompression can produce 6.5±1 km of magma
(e.g. Oceanic Crust, Dick et al. 2003)

Legend:
- Deformation
- Magmatism
- Distance (km)
- Continental crust
- Magmatic crust
- Base Extrusives
- Bathymetry
- Top Intrusives
- Moho

Tomasi, Kusznir et al. in prep.
How to explain endmember type rifted margins
magma budget vs. relative timing of magma formation as a function of extension
(Tomasi, Kusznir et al. in prep.)

Main question:
• How to explain endmember margins?

Legend:
- continental crust
- magmatic crust

magma formation as function of extension

(EGU_2020_TS6.4: Rift to Ridge: the record of continental breakup processes)
Magma at rifted margins: when, where and how much?

(Tomasi, Kusznir et al. in prep.)
A “first” order description of rifted margins

*magma budget vs. delay*

---

**magma formation as function of extension**

- **Magma-poor**
- **Magma-rich**

(Tomasi, Kusznir et al. in prep.)
Main questions:

• What controls the distribution of magma-rich & magma poor margins?
• What is the role of “plumes” and “inheritance”?
• How can we describe magmatic systems?

Future work

Haupert et al. 2016

(Tomasi, Kusznir et al. in prep.)

After Laurent Gernigon