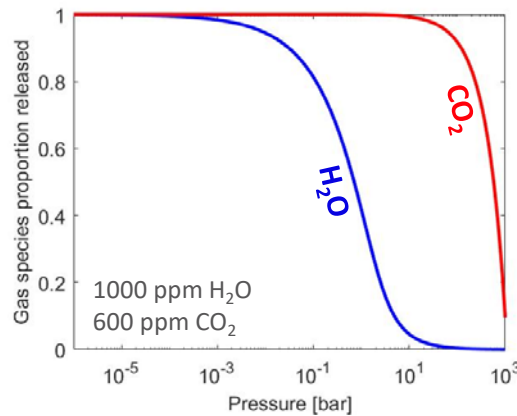


Effects on the volatile release from magmatic intrusions

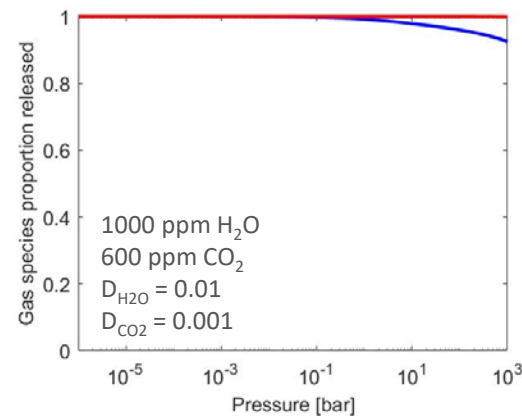
Vulpius, S.^{1*} and Noack, L.¹

¹Freie Universität Berlin; *sara.vulpius@fu-berlin.de

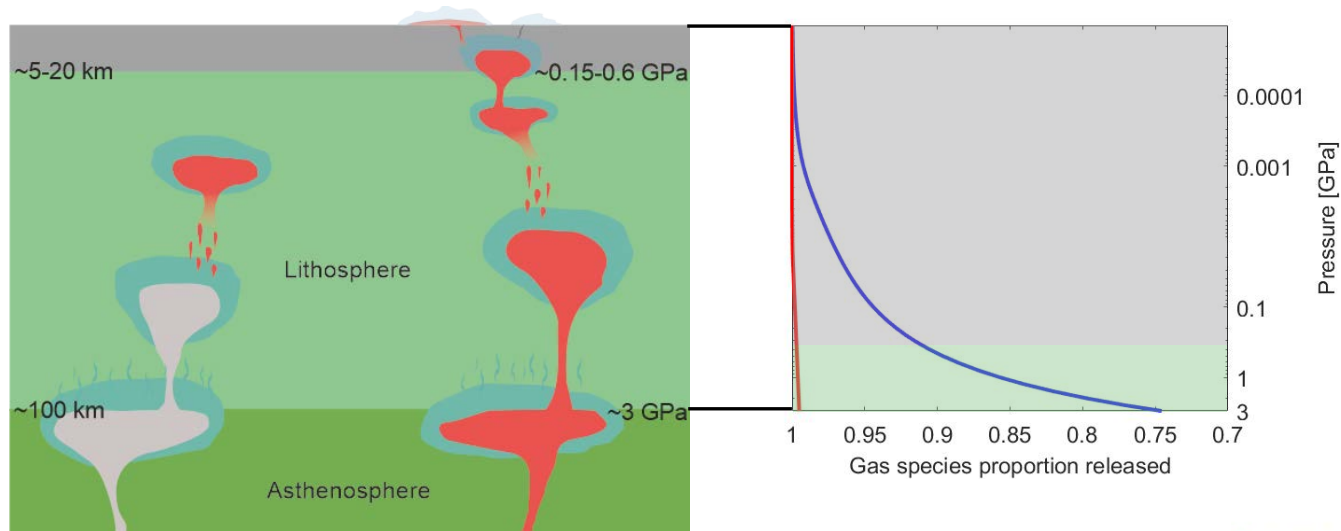
Without fractional crystallization



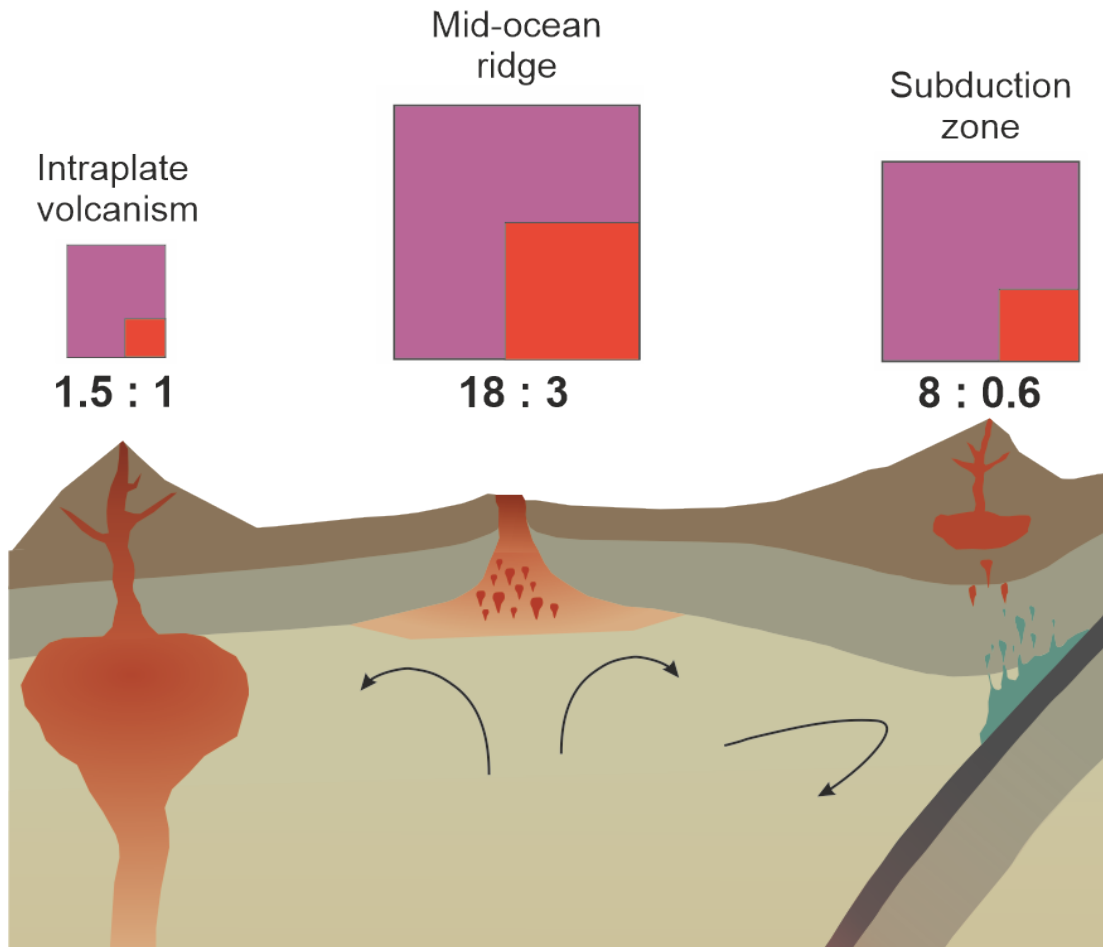
With fractional crystallization



Modified after Gaillard and Scaillet 2014



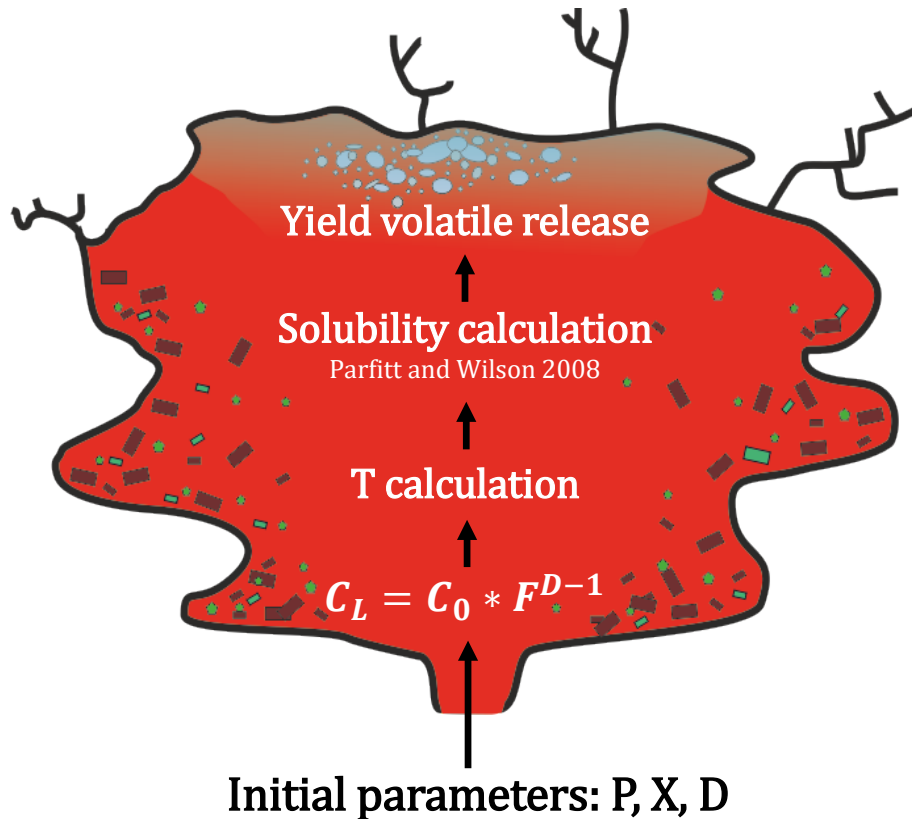
Motivation



After Schmincke 1986

- More intrusive than extrusive magma production today
- Intrusive volatile release is highly relevant

Methods



Fractional crystallization of basaltic magma body

→ Cooling + crystallization

→ Melt enrichment of incompatible elements including volatiles

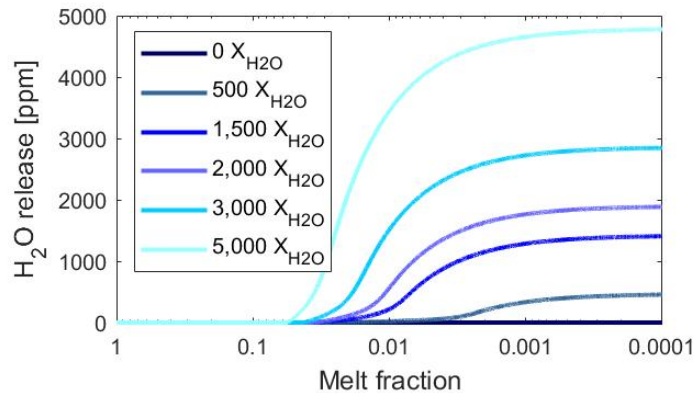
→ Oversaturation → solubility exceedance

→ Release of volatiles + ascent

Results: Variation of initial volatile content

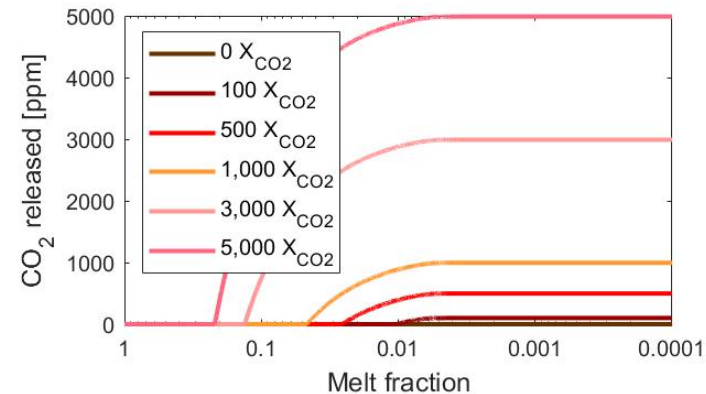
Variation of $X_{\text{H}_2\text{O}}$

Fixed: 1 GPa; 600 ppm CO_2 ; $D_{\text{H}_2\text{O}} = 0.01$; $D_{\text{CO}_2} = 0.001$



Variation of X_{CO_2}

Fixed: 1 GPa; 1000 ppm H_2O ; $D_{\text{H}_2\text{O}} = 0.01$; $D_{\text{CO}_2} = 0.001$



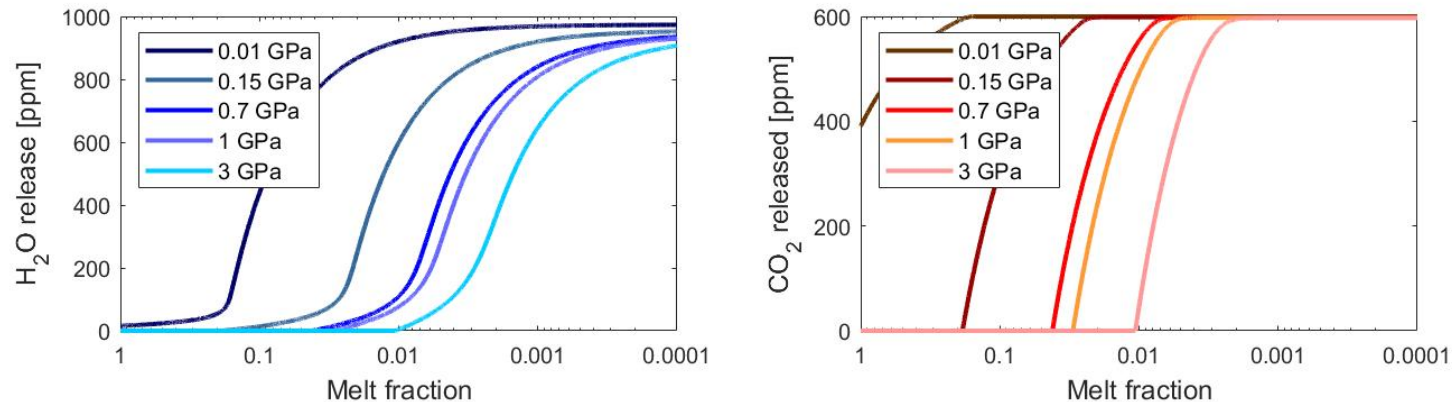
- Amount of H_2O and CO_2 that can be released from the melt as a function of the melt fraction with varying initial volatile content
- The higher the initial volatile content of the melt, the more can be released
- At the end of the crystallization process, H_2O and CO_2 are almost entirely released for each case

→ **Strong influence of initial content on volatile release**

Results: Variation of initial volatile content

Variation of pressure

Fixed: 1000 ppm H₂O; 600 ppm CO₂; $D_{\text{H}_2\text{O}} = 0.01$; $D_{\text{CO}_2} = 0.001$



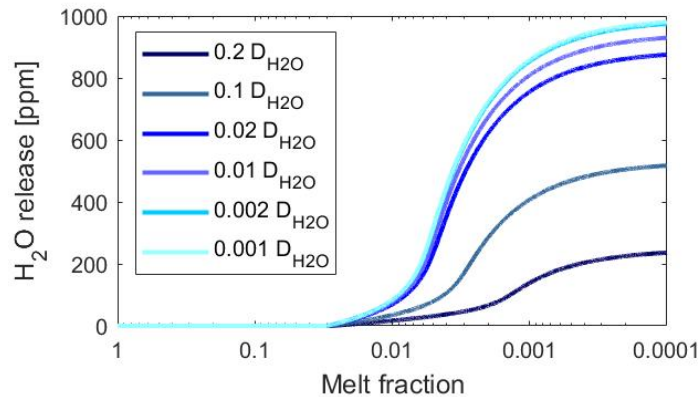
- Amount of H₂O and CO₂ that can be released from the melt as a function of the melt fraction with varying pressure
- At low pressures, the solubility is low and the release initiates from the beginning on
- But: at the end of the crystallization process, H₂O and CO₂ are each released almost completely even at 3 GPa (asthenosphere-lithosphere boundary)

→ **Minor influence of the pressure**

Results: Variation of initial volatile content

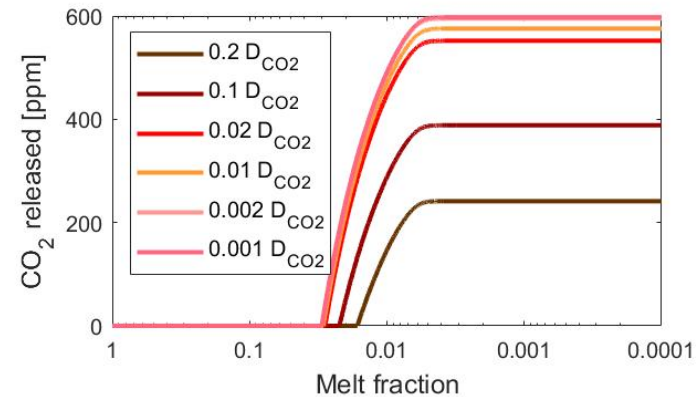
Variation of $D_{\text{H}_2\text{O}}$

Fixed: 1 GPa; 1000 ppm H_2O ; 600 ppm CO_2 ; $D_{\text{CO}_2} = 0.001$



Variation of D_{CO_2}

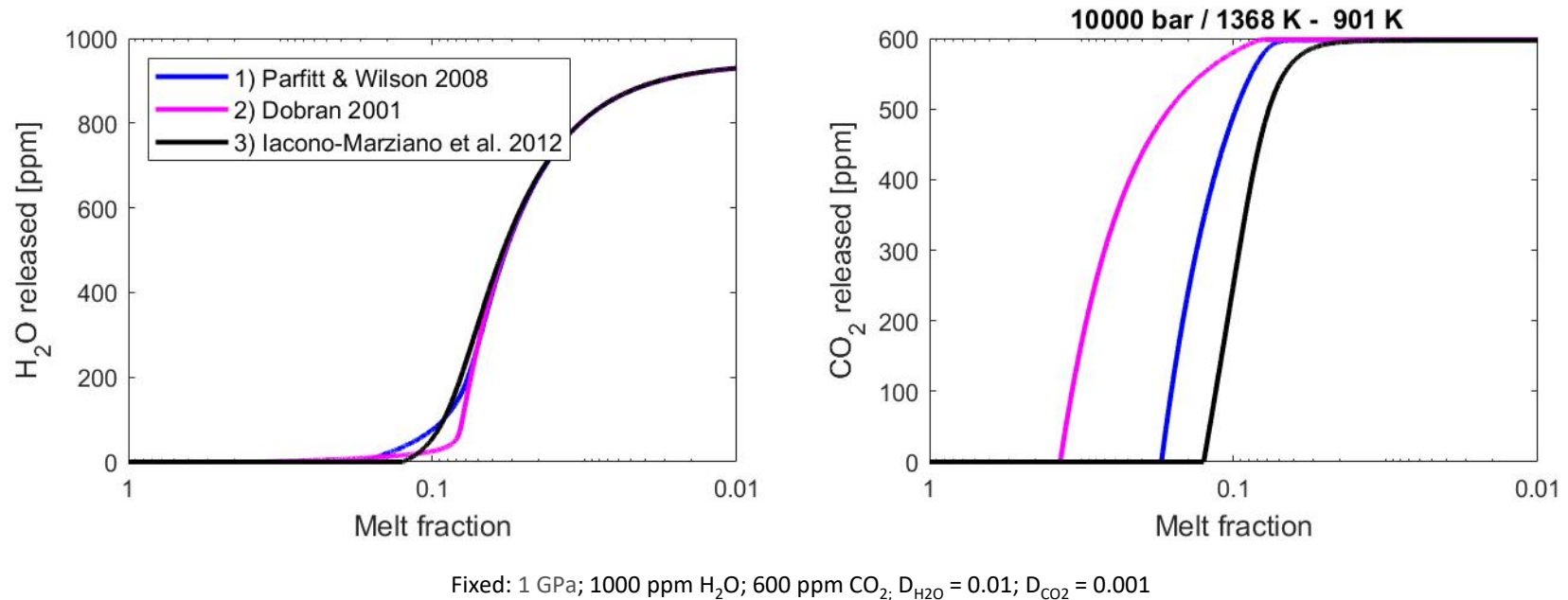
Fixed: 1 GPa; 1000 ppm H_2O ; ; 600 ppm CO_2 ; $D_{\text{H}_2\text{O}} = 0.01$



- Amount of H_2O and CO_2 that can be released from the melt as a function of the melt fraction with varying partition coefficient
- Stronger effect of the partition coefficient on the volatile release only at unrealistically high values of > 1.0

→ **Almost no influence of the partition coefficient on volatile release**

Results: Comparison of solubility calculations



- Amount of H₂O and CO₂ that can be released from the melt as a function of the melt fraction calculated for different solubility calculations

→ Almost no difference using different solubility laws

Conclusion

Intrusive volatile release considering fractional crystallization

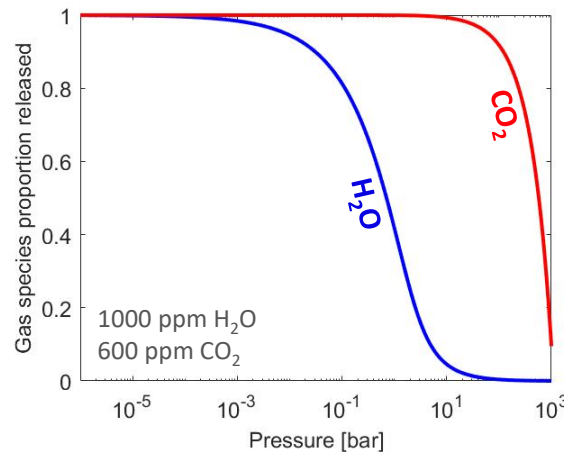
- Volatile release considerably increased
- Volatile release from magma bodies within lithosphere possible

Main factors influencing volatile release

- Initial volatile content

Minor factors

- Pressure
- Partition coefficient
- Solubility law



Modified after Gaillard and Scaillet 2014

