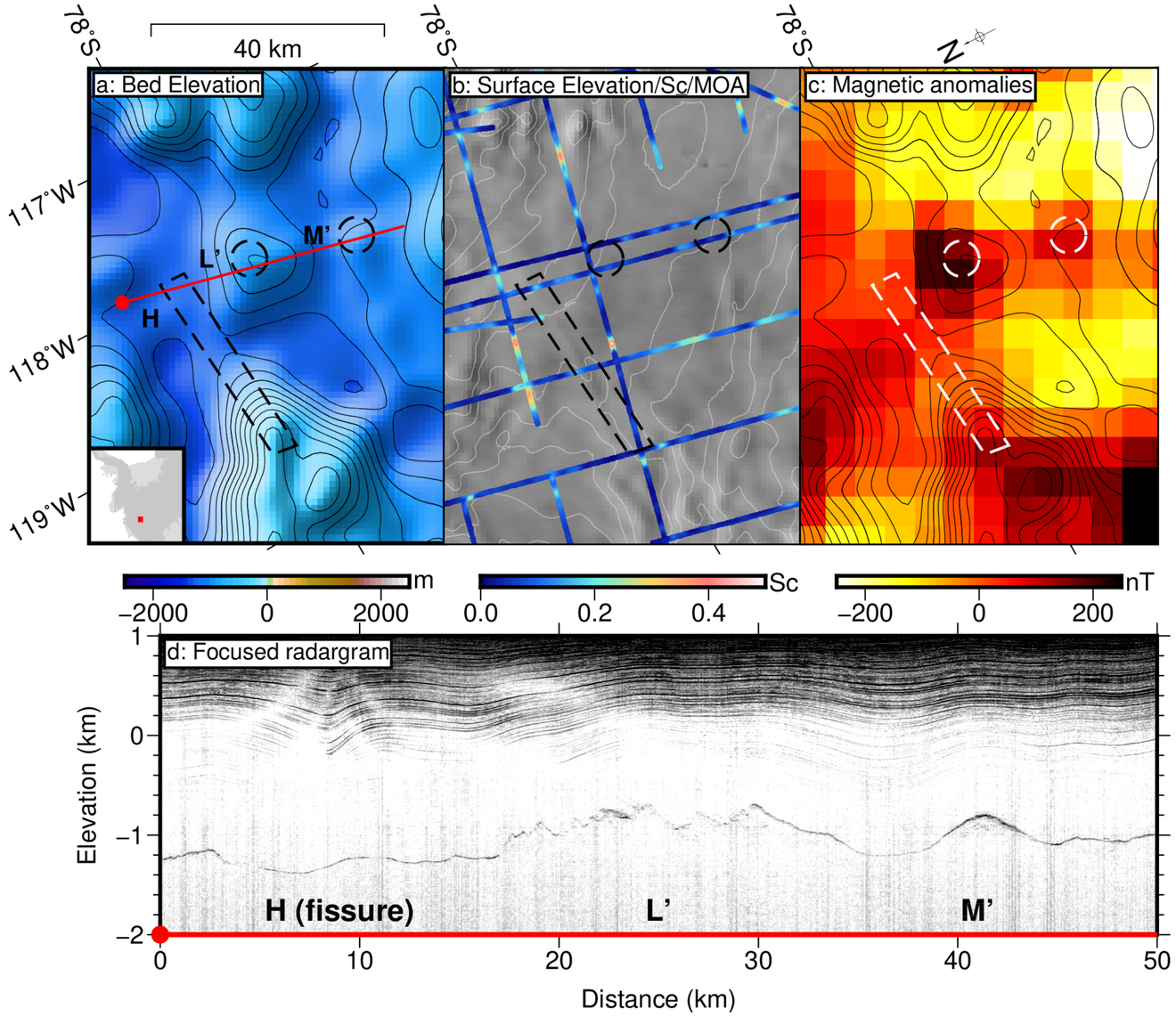
Active subglacial volcanism in West Antarctica as assessed by airborne geophysics: Distribution and context

EGU2020-21391
EGU General (Virtual) Assembly 2020

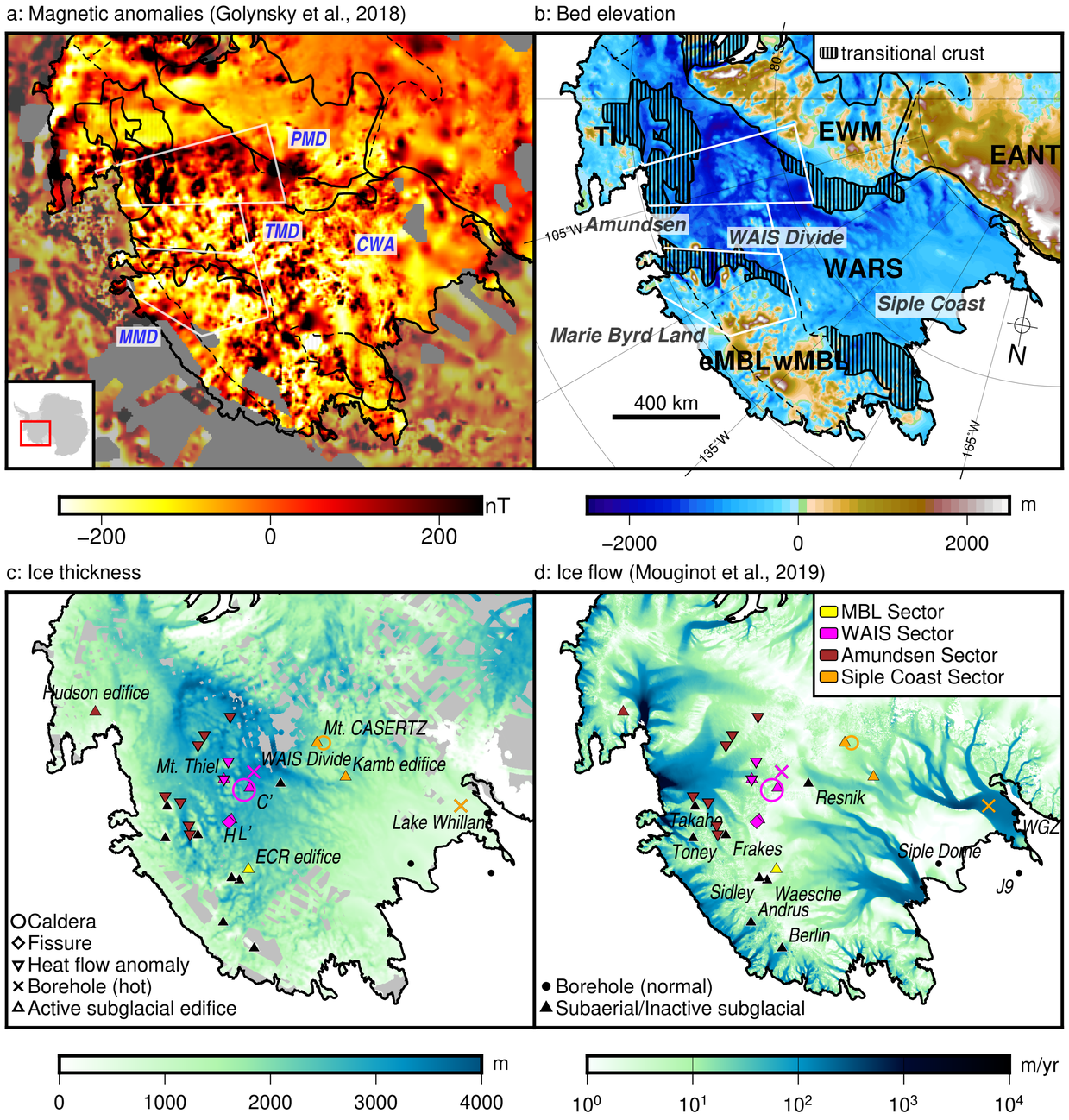
Donald Blankenship[1], Enrica Quartini[1,2,] and Duncan Young[1]
[1]University of Texas Institute for Geophysics, University of Texas at Austin, Austin, United States of America
[2]School of Earth and Atmospheric Sciences, Georgia Institute of Technology, Atlanta, GA, USA



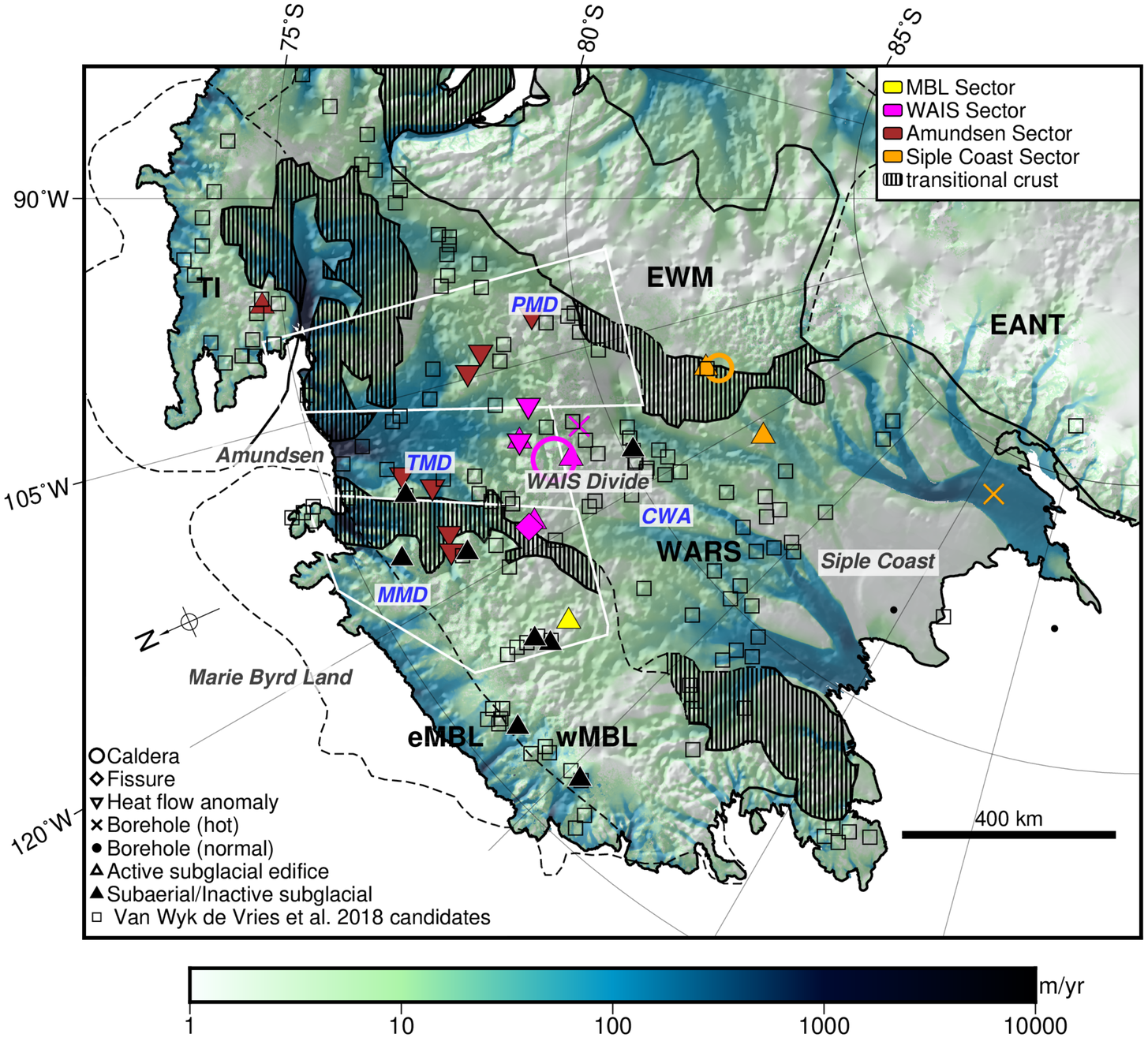
We evaluate aerogeophysical data in West Antarctica for evidence of active subglacial volcanism in glaciological and geological context. We use a combination of ice penetrating radar, potential fields and surface elevation/ imaging data.

An example site (from master thesis by H Danque, 2008) in Central West Antarctica on this slide)

Results are discussed in a paper in review: *Quartini, E., Blankenship, D. D., and Young, D. A.,in review, Active subglacial volcanism in West Antarctica, Geological Society Of London, Special Publication*



- Distinct magnetic domains identified
  (Doctoral dissertation by E. Quartini 2018)
  - Pine Island Magnetic Domian (***PMD***)
  - Thwaites Magentic Domain (***TMD***)
  - Marie Byrd Land Magnetic Domain (***MMD***)
  - Central West Antarctica (***CWA***)
- Gravity, geology and topography indicate crustal blocks
  (Doctoral dissertation by T. Daimini (*nee* Diehl) 2007)
  - east/west Marie Byrd Land blocks (**eMBL/wMBL**)
  - West Antarctic Rift System (**WARS**)
  - Ellesworth Mountains block (**EWM**)
  - Thurston Island block (**TI**)
  - East Antarctica (**EANT**)
- Four sectors of volcanism mapped out in glaciological context.



- These candidates differ from those recentlly mapped out by Van Wyk de Vries 2018, in that we focused on active, hot, targets, but also primarily worked from line data, as opposed from heavily interpolated compilations.
- We content that Van Wyk de Vries 2018 misses some candidates for active volcanism, but also overestimates the total number of viable recent volcanic centers.

Geologic Context for Subglacial Volcanism

- The majority of active subglacial volcanic sites in West Antarctica concentrate along crustal boundaries and within central WARS, which are regions of thinned, rifted crust that have been tectonically reactivated during multiple stages of WARS formation. Subglacial volcanic sites also overlap with areas of relatively thick ice and slow ice surface flow, both of which are critical conditions for the preservation of volcanic records.

- Factors such as crustal age and thickness can explain the lack of active subglacial volcanism within sectors characterized by thicker crust such as crustal blocks and the Siple Coast (Chaput et al., 2014).

- The lithosphere underlying Thwaites Glacier's main trunk is likely to have cooled, and volcanic activity in the area ceased since the last emplacement of basaltic wedges during the early mid-Mesozoic stages of WARS formation (Gohl et al., 2013).

Glaciological Context for Subglacial Volcanism

- The glaciological regimes in each sector impose biases to the preservation of subglacial volcanic records which can potentially prevent detection of volcanic activity even where present.
- Subglacial eruptions under thin ice produce more brittle and less consolidated deposits, such as hyaloclastites, compared to eruptions under the high pressure conditions of thicker ice columns, where more erosion-resistant pillow lava flows form.
- As a result, the products of volcanic activity under thinner ice columns are more prone to erosion and removal by the ice sheet. This is particularly relevant in regions of fast ice flow, such as the Siple Coast and main trunk of Thwaites Glacier. While Thwaites Glacier is a region of high driving stresses and thick ice, the Siple Coast ice streams are characterized by thin ice, making this a region particularly prone to loss of subglacial volcanic records.
- By altering the ice's thermal structure and generating basal melt water, heterogeneous geothermal flux has the potential to affect ice dynamics in all sectors of West Antarctica where active subglacial volcanism is observed.