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Interactive comment on "Correlation between tectonic stress regimes and methane seepage on the west-Svalbard margin" *by* Andreia Plaza-Faverola and Marie Keiding

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We are thankful for the comments. We acknowledge that we need to add emphasis on some of the key points to ensure the message is conveyed clearly. The comments by reviewer 1 will guide the revision of the manuscript.

Our main goal is to report on a modeling exercise that has a clear intention of investigating the kind of stresses generated exclusively by oblique spreading at both mid-ocean ridges in the Fram Strait (Knipovich and Molloy) and how these stresses correlate with the distribution of seepage activity. While the modeling approach is highly simplified, i.e., based on assumptions of isotropic, homogeneous, elastic rheology as well as flat

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earth and spreading symmetry, it represents a first and important step for the investigation of near-surface stresses in this Arctic region. Our next steps will consist in modeling stresses from glacial dynamics to finally integrate different sources of stress in a numerical model of higher complexity.

For improving the manuscript, we intend to:

1. Ensure that we convey clearly that the modeling attempts to investigate stresses exclusively due to the spreading at the Molloy and Knipovich slow spreading ridges (i.e., that other sources of stress are neglected in the model). Hence, the modelled stresses are not to be understood as the actual stress field in the region. In addition, the discussion will address more clearly that there are other potential sources that influence present and past stress fields in the region. We will argue more substantially that regardless the influence of other stress sources, the tensile zone predicted by our models may on itself explain present day seepage distribution. We will also discuss that assuming that seepage occurs where permeability of faults and fractures is favored in a tensile regime, other sources of tensile stress were needed in the past to explain seepage where seabed pockmarks are inactive today.

2. Make a more explicit reference to the sensitivity test we include as supplement. The model we report on here, indicates that there are spatial changes in the stress field caused exclusively by oblique spreading at the mid-ocean ridges which coincide with a change in seepage activity and can be supported by the morphology and distribution of faults. While there is no direct stress observations from bore holes in the region, indirect stress observations from earthquake focal mechanisms support the stress field predicted by the model. The paper includes a sensitivity test showing how the distribution of the predicted tectonic stress field changes while changing key parameters in the model. A tensile zone extending north of the Knipovich ridge seems to be a robust feature of the model. This is a key result because this zone of tensile stress coincides with the zone of active seepage at present day. In addition, the model results support the postulation by Crane et al., 2002 and Vanneste et al., 2005 where outcropping faults

north of the northward termination of the Knipovich ridge indicate northward propagation of the rift system (i.e., this is the region of tensile stresses predicted by the models we present here).

3. Discuss more substantially the validity (or not) of the symmetry assumption in the Okada models. Different studies rely in this assumption of symmetry in this Arctic region based on what can be observed from available magnetic anomaly maps (e.g., Johnson et al., 2015).

4. Extend the discussion about the effect of present-day glacially induced stress on Vestnesa (on the order of 0-2 MPa based on analogy with the models from the Fennoscandia area; by e.g. Lund et al., 2009; Steffen et al., 2006).

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