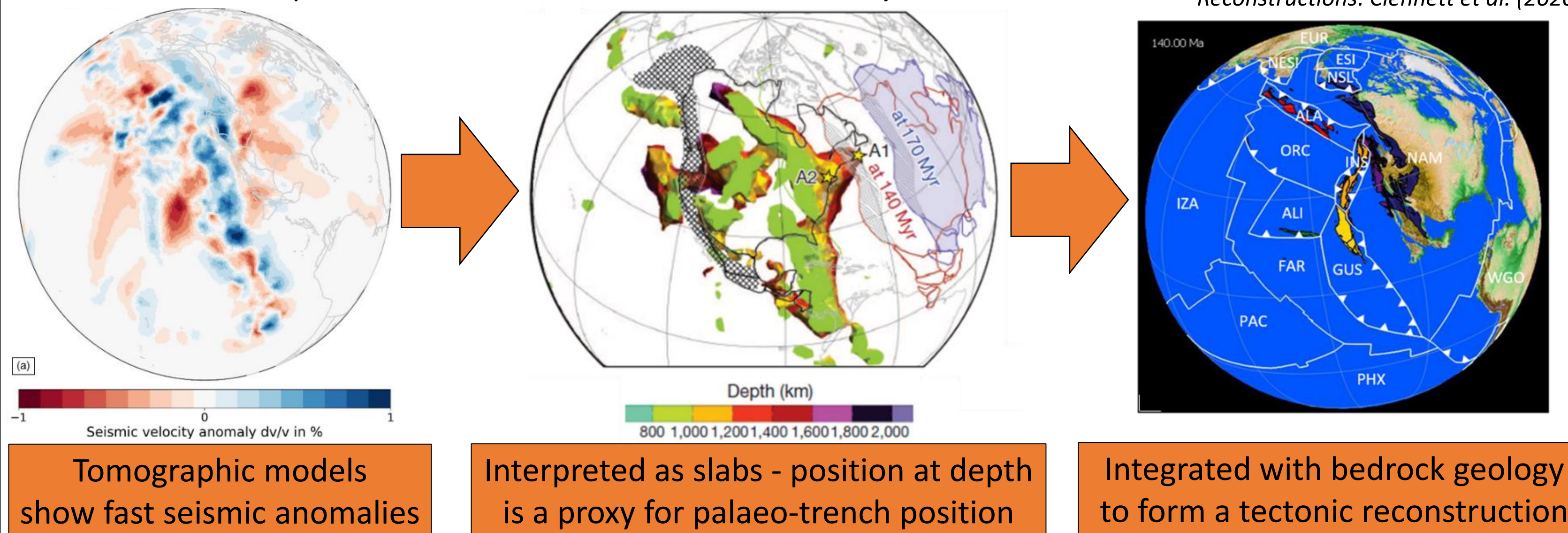


Tomotectonic constraints on the assembly of the western Arctic region and central Alaska: progress, problems and future direction

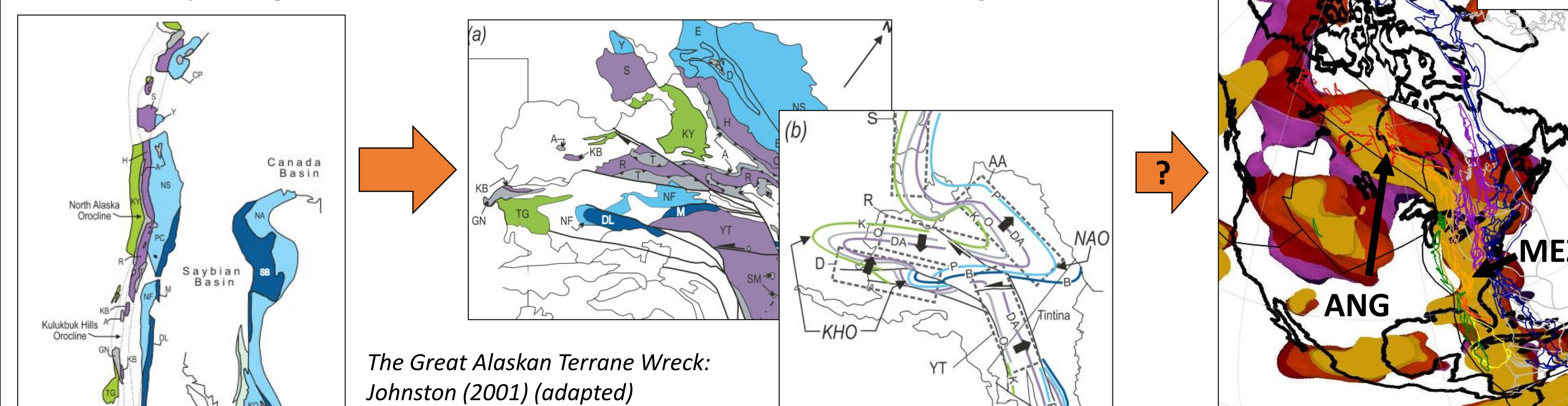
2 Tomotectonic Analysis

Subducted slabs in the mantle are part of the geological record and can be used as additional constraints in tectonic reconstructions. Assuming that slabs have an average sinking rate of ~10 mm / year, and that eventually the slab will sink vertically when a stationary trench is above it (see right), the position of the slab at depth can be used as a proxy for where the trench was in the past (i.e. the position of the slab at 1000 km depth is possibly the position of the trench it was subducting into at 100 Ma). By combining these constraints with bedrock geology and palaeomagnetic data, we can make more accurate tectonic reconstructions, a process which we call “tomotectonic analysis”.



3 Central Alaska

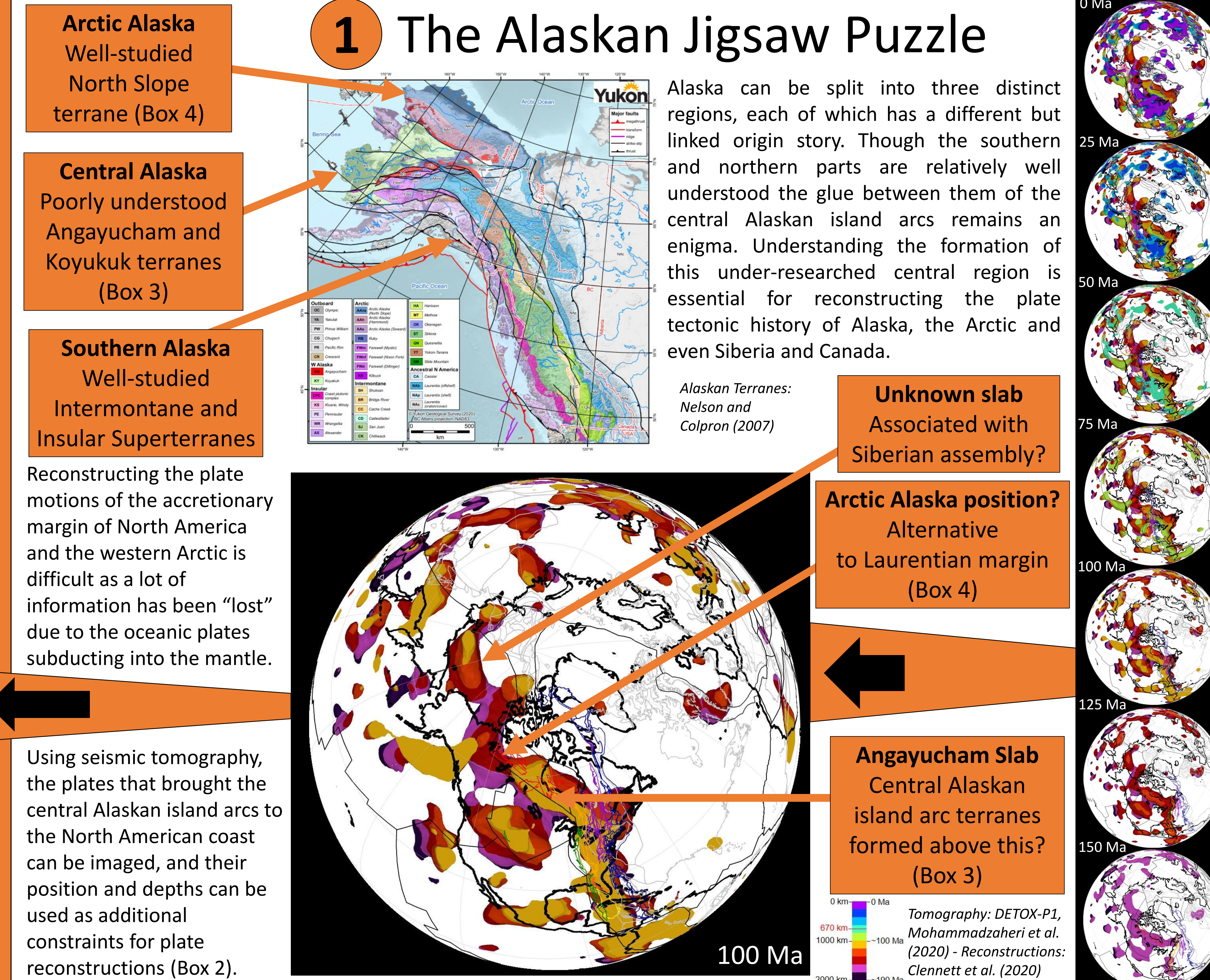
The central Alaskan terranes of the Angayucham and Koyukuk are island arcs which formed above subduction zones. One of the only large-scale models for the accretion of these terranes is the “terrane wreck” model (Johnston, 2001) which has inferred that central Alaska is a crumpled (or oroclinal) assemblage of “train cars” of a formerly straight intra-oceanic arc, thousands of kilometres long (see below).



Where was the absolute location of this inferred arc? The Angayucham slab (above right – ANG) is the natural place because N. America overrode this area of the mantle during the Cretaceous times, when the central Alaskan arcs were gradually going extinct. The slow and progressive collision, over tens of millions of years, would have crumpled the arc assemblage (green & purple – above left) along the continental margin (light & dark blue – above left). More work needs to be done on this area to match up the Angayucham slab with the central Alaskan terranes, but we propose to use a similar method employed by Sigloch & Mihalynuk (2017) and Clennett et al. (2020), where they showed that the geological evidence for Southern Alaska (the Insular superterrane) is consistent with a formation positioned above the Mezcalera slab (above right – MEZ).

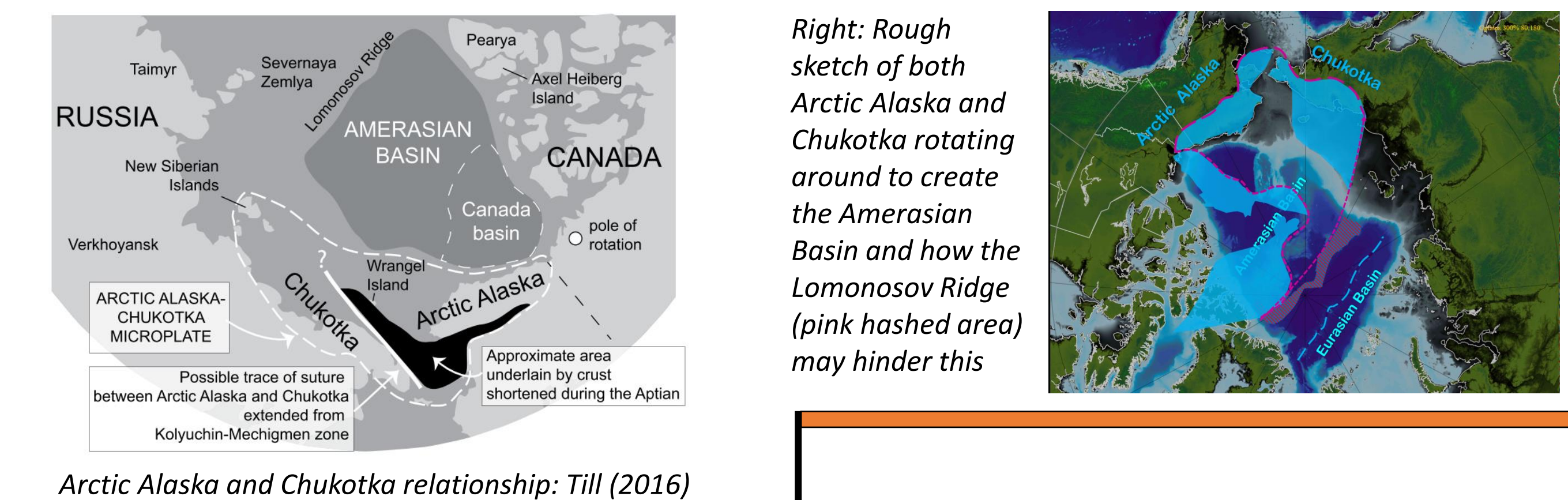
- The **western Arctic region** and **central Alaska** have an **enigmatic origin** as plate restorations are hindered by the **loss of oceanic tectonic plates** in subduction zones
- The **structure of subducted slabs** in the mantle gives **additional constraints** for tectonic reconstructions by providing possible **positions of palaeo-trenches**
- By **combining** constraints from **tomography** with **bedrock geology** datasets, a **tectonic reconstruction** can be produced, a process we call “**tomotectonic analysis**”
- Lack of **tomographic resolution** has hindered interpretation in the past
- New seismic data from **EarthScope Transportable Array (TA) in Alaska** can be used to make a **high-resolution tomographic model** of the mantle beneath this region
- Here we show some first order **observations** of how **existing tomographic models** suggest **new interpretations** of generally accepted **tectonic reconstruction models** and why a **new tomographic model** is needed

1 The Alaskan Jigsaw Puzzle



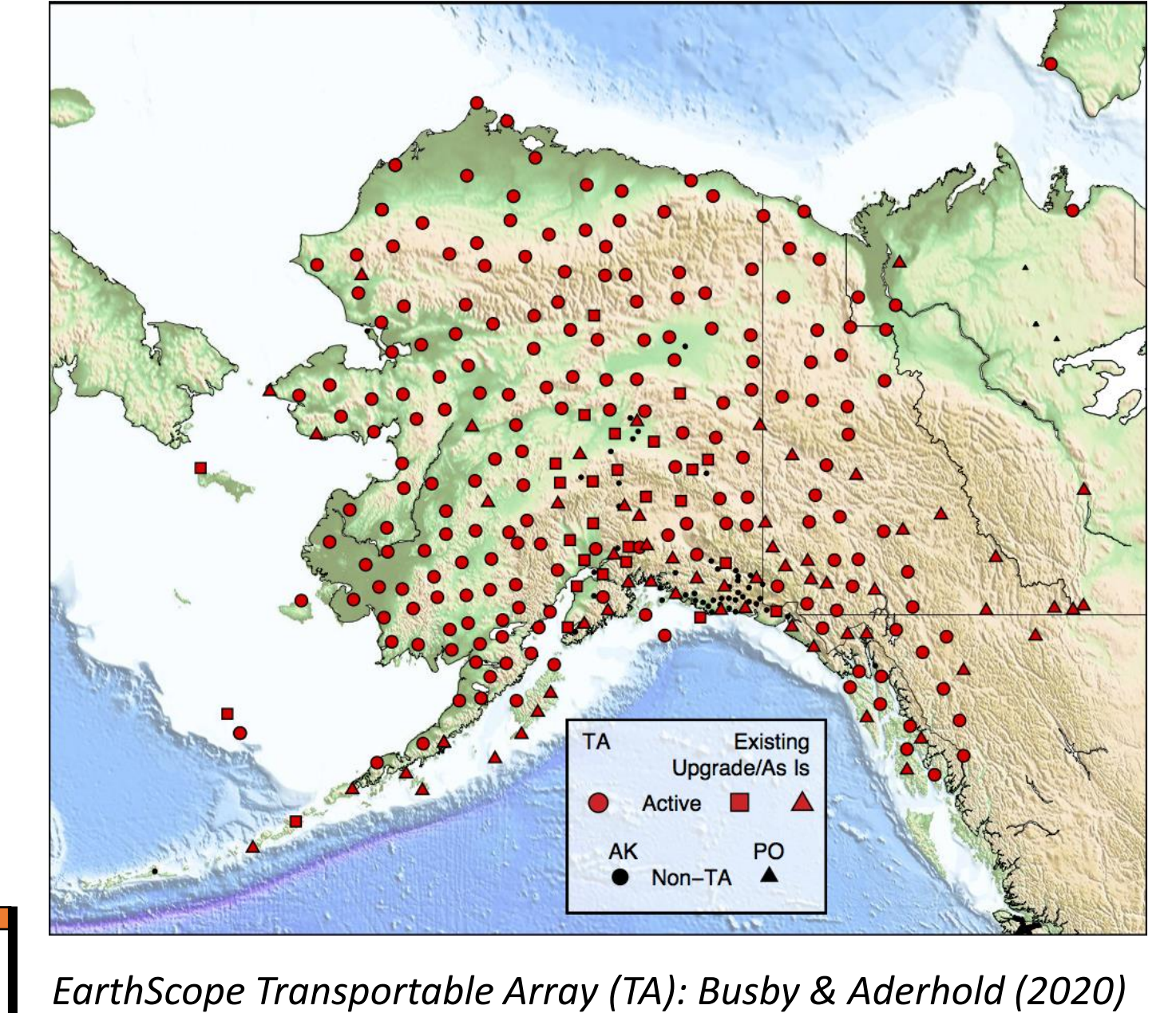
4 Western Arctic

There are various theories for how Arctic Alaska came to form the northernmost part of Alaska. One theory is that it swung round the Laurentian coastline like a “windshield wiper” (e.g. Grantz et al, 1990) and opened up the Amerasian basin, becoming a “backstop” for the central Alaskan island arcs. However, it also seems plausible that Arctic Alaska could have sat at the far end of the central Alaskan island arcs above the Angayucham slab, as this slab is the right age and depth. Other discrepancies appear if the Siberian terrane of Chukotka, or at least part of it (e.g. Till, 2016, below left), is sutured to Arctic Alaska, as there is then not enough space for both Chukotka and Arctic Alaska to rotate around the Amerasian basin without hitting the prominent Lomonosov ridge (below left). There are also unassigned slabs further north than Angayucham that could have produced terranes involved in Siberia and the Arctic’s formation.



5 Future Tomographic Models

Tomotectonic analysis of this region has been hindered in the past by the tomographic resolution of the slabs not being sharp enough. However, since 2014 the EarthScope Transportable Array (USArray) of 280 seismic stations have been deployed in Alaska, massively increasing the coverage. We are currently using this wealth of data to create a new seismic tomography model which we hope will answer some of the questions outlined on this poster.



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