

THE INTERNATIONAL CONFERENCE ON THE 120TH ANNIVERSARY OF THE BULNAY EARTHQUAKE: ADVANCES IN ASTRONOMY AND GEOPHYSICS





Structure of the Upper Mantle Beneath Mongolia Based on Surface Waves: Consequences for the Western Edge of the Amurian Plate

Baigalimaa Ganbat¹, Kazunori Yoshizawa², Demberel Sodnomsambuu³, Ulziibat Munkhuu¹

(1. Institute of Astronomy and Geophysics of Mongolia, MAS, 2.Dept Earth & Planetary Sciences, Faculty of Science, Hokkaido University, 3. Mongolian Academy of Sciences)

1.Introduction

Mongolia is a part of the Central Asian Orogenic Belt, long-lasted accretionary orogen in the central and 60° eastern Asia.

- East Asia has experienced tectonic deformations during Cenozoic due to 50° the collision between the Indian, the Pacific, Eurasian plates, and the subduction of Philippine sea plates 40° beneath Japan.
- Mongolia border 30° locates between Eurasian and Amurian Plates.

Purpose: Unravel the current tectonics and mantle dynamics under Mongolia and Amurian Plate using multi-mode surface waves with high-density networks.

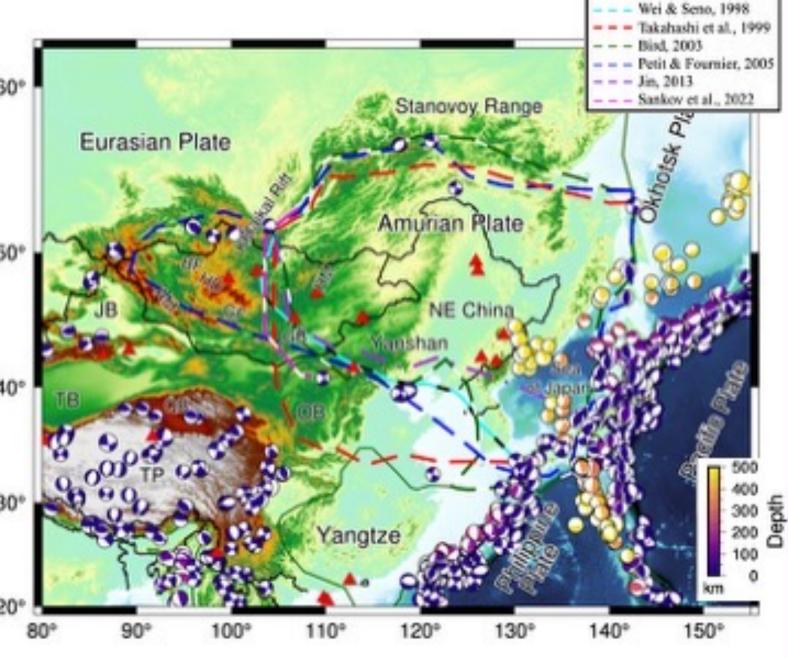


Figure 1. Tectonic and topographic map of eastern Asia

2. Methods

Flow of 3-stage Surface Wave Tomography

Step1: Multi-mode phase speed measurements

Nonlinear waveform fitting with Neighborhood Algorithm (Yoshizawa & Kennett, 2002a, GJI; Yoshizawa & Ekström, 2010, GJI)

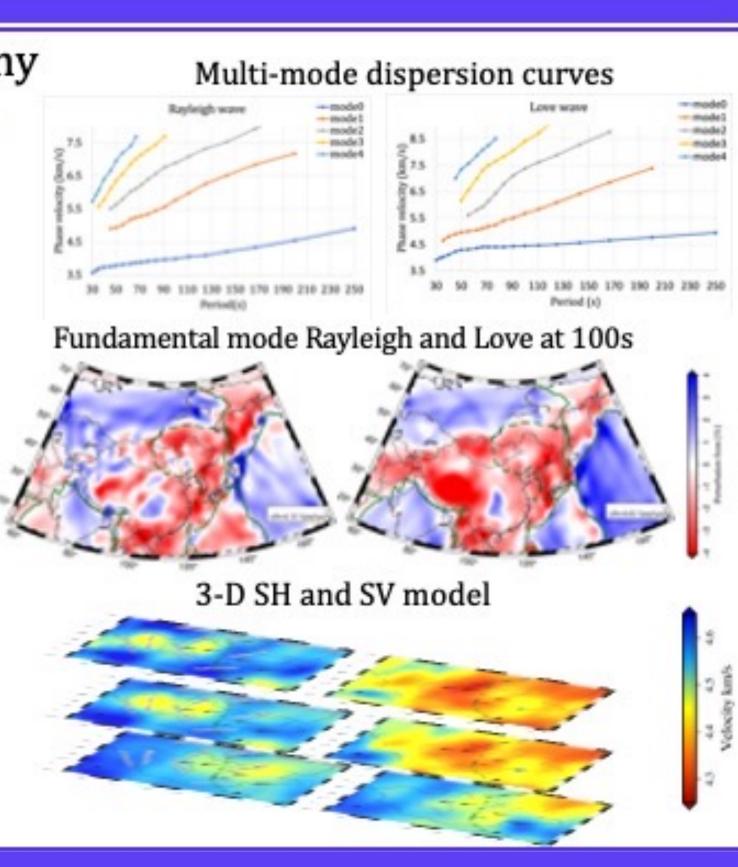
Step2: Multi-mode phase speed maps

Surface-wave tomography (Yoshizawa & Kennett, 2004, JGR)

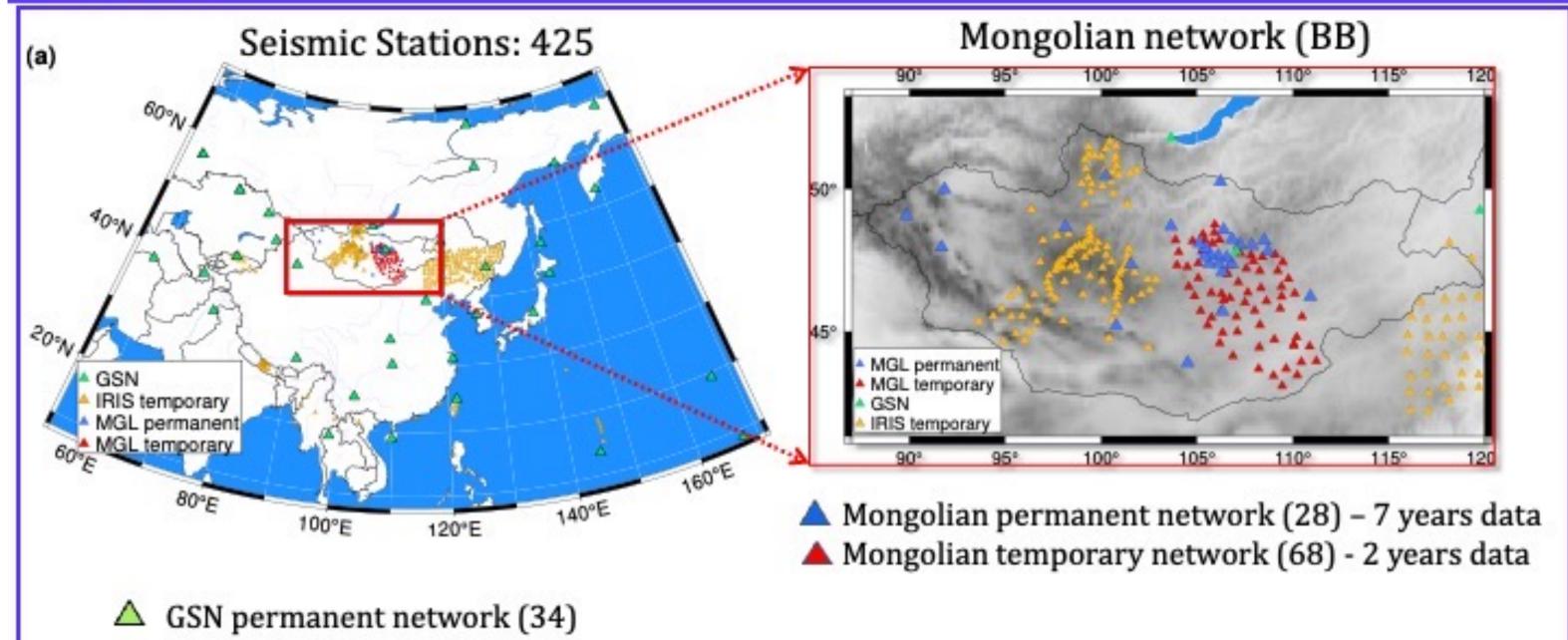
Step3: 3-D S wave model

Inversions for local anisotropic S-wave speed models (Yoshizawa, 2014, PEPI)

моде	wave	Love wave
0	30.3-200.0s	33.3-200.0s
1	55.5-166.7s	66.7-166.7s
2	55.5-142.9s	62.5-111.1s
3	45.5-90.9s	50.0-83.3s
4	35.7-62.5s	45.5-66.5s



3.Datasets



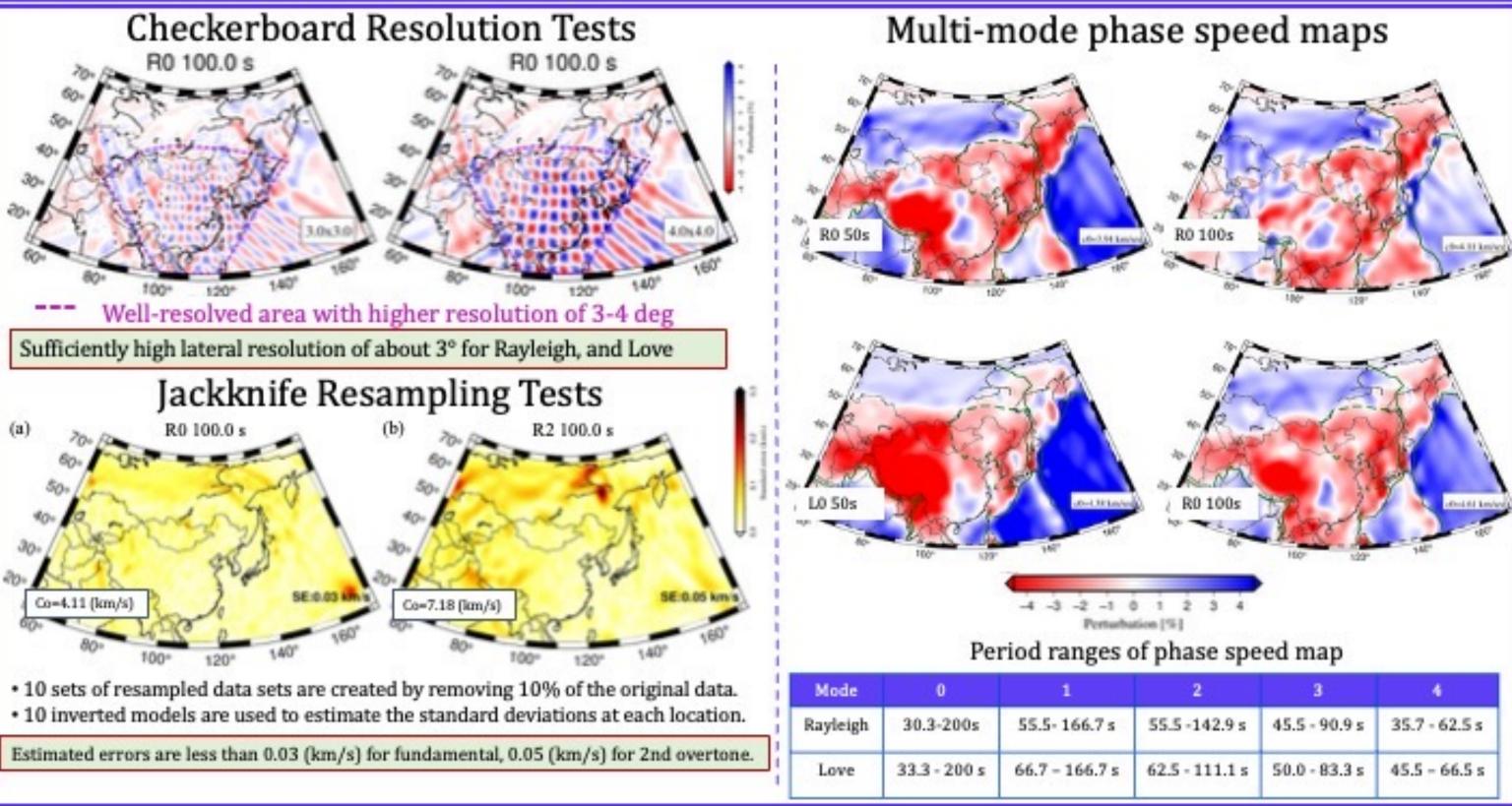
Events: $1655(2009-2021 (\ge Mw 5.8))$ Ray path coverage Ray path density Number of phase speed measurements Number ray-paths in 20×20 Paths: Rayleigh~70000; Love~40000 (Fundamental mode) The main target region (around Mongolia) is covered well with dense ray paths Rayleigh~ 40000, Love~ 5000(Higher-mode)

4.Multi-mode phase speed maps

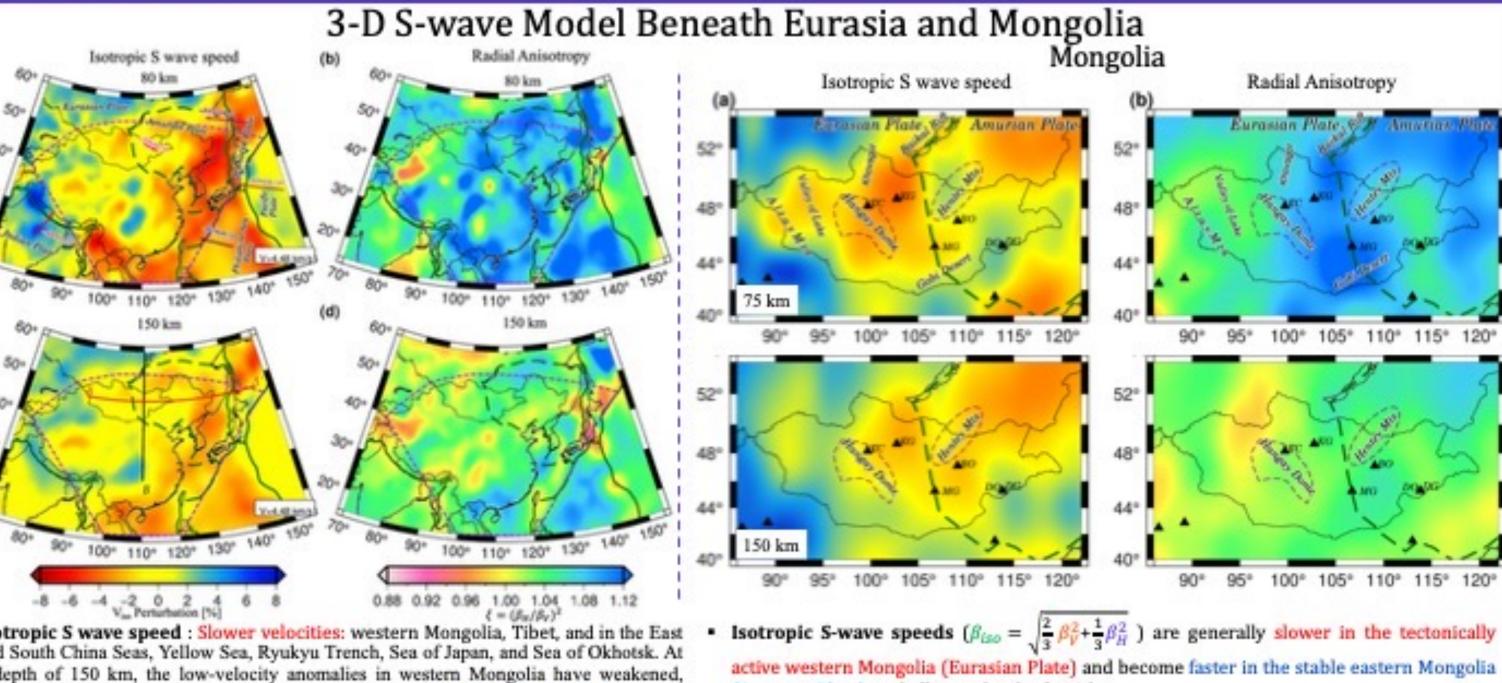
NECESSArray (127) - 2 years data

PASSCAL (112) - 2years data

▲ IRIS temporary network



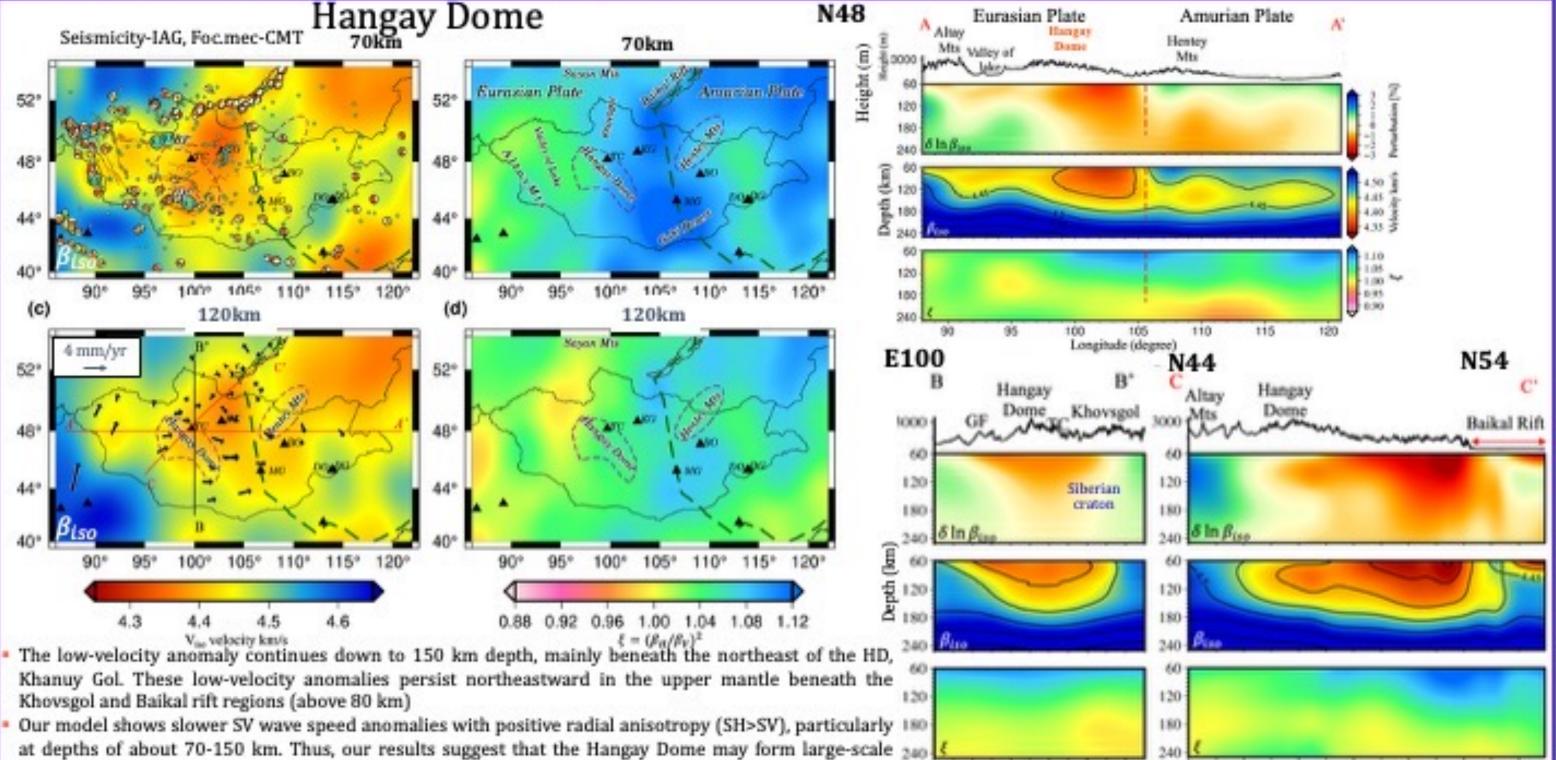
5.3-D S wave model



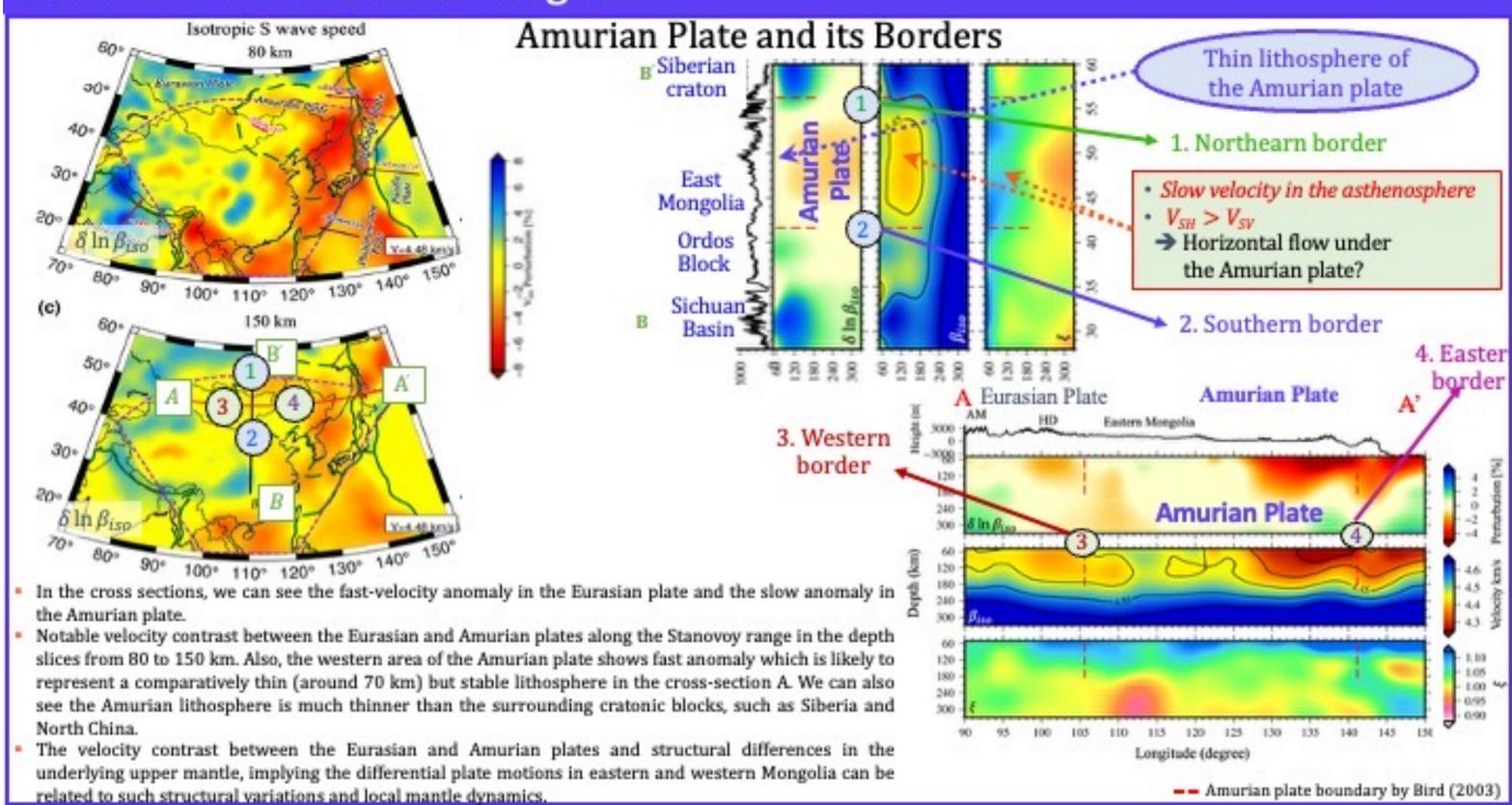
Isotropic S wave speed: Slower velocities: western Mongolia, Tibet, and in the East and South China Seas, Yellow Sea, Ryukyu Trench, Sea of Japan, and Sea of Okhotsk. At a depth of 150 km, the low-velocity anomalies in western Mongolia have weakened, while the eastern marginal seas still show slower anomalies. Faster velocities: Siberian craton, Sichuan basin, Ordos block, Tarim basin, and Sichuan basins. This fastvelocity anomaly continues down to 150 km depth. Radial anisotropy Most region exhibits positive radial anisotropy (\$>1), part of Tibet and under Japan. At a depth of 150 km, the general anisotropy tends to be weaker than shallower depth.

- (Amurian Plate) at shallower depth of 100 km. Radial anisotropy $(\xi = (\frac{\beta_H}{2})^2)$ shows a faster SH wave speed than SV in almost the entire
- Mongolian lithosphere above 100 km depth, except for the southern part of the western Sayan Mountains. Below 150 km depth, SH wave speed becomes slower in Hentey Mts.

6.Discussion of Western Mongolia Hangay Dome Seismicity-IAG, Foc.mec-CMT



6.Discussion of Eastern Mongolia



Conclusions

* We constructed a new anisotropic 3-D S-wave model beneath central Eurasia around Mongolia from multi-mode phase speeds of Rayleigh and Loves waves, using seismic networks in Mongolia.

800 1000 1200

- S-wave speeds in the Mongolian upper mantle (above 100km) exhibits a significant velocity contrast between the western and eastern areas. * The significant velocity contrast in Mongolia may reflect the enigmatic boundary between the Eurasian and Amurian plates.
- **In western Mongolia:**

may have been lost delaminated, as indicated by Feng.2021, Zhao.2021, and Huang2022.

- Altay Mts: slow anomaly down to 100 km India -Asia collision? Hangay Dome: slow anomaly down to 150 km Partial melt at shallower depth? **❖** In eastern Mongolia:
- Along the Amurian plate boundary: fast anomaly → Relatively stable lithosphere (70-100 km)?

partially molten layers in the top 150 km depth, and the lithosphere here may be significantly weaker or

- * The structural differences in the upper mantle beneath the Eurasian and Amurian plates may suggest its relation to the distinctive plate motions in eastern and western Mongolia.

44 46 48 50 52

Latitude (degree)

Amurian plate: Eastern Mongolia Thinner crust Mantle lithosphere 110 Longitude (degree)