

THE DECEMBER 5, 2014 KHANKH EARTHQUAKE, KHUVSGUL, MONGOLIA

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ABSTRACT

On December 5, 2014, at 18:04 UTC (2014.05.06 02:04 Ulaanbaatar time), a magnitude ML 5.3 earthquake occurred in the Khuvsgul lake, in the northern of Mongolia, a seismically active region influenced by the complex tectonic interactions of the Baikal Rift Zone (epicenter coordinates: approximately 51.37°N, 100.63°E). The focal depth was estimated at 10–15 km, placing it within the upper crust and was felt across Khuvsgul province, including the towns of Hatgal, Murun, and even in parts of southern Siberia (Irkutsk and Tuva). Khankh sum (Turt) is located very close (~15–20 km) to the focal zone of the earthquake and structural damage was minimal, but some local residents reported strong ground shaking. Given its moderate magnitude residents in Turt likely felt a notable jolt, but regional construction (mostly low-rise, wood or gers) would have absorbed it with few or no effects. The December 5,2014 Khankh earthquake was significant scientifically felt by instruments, triggered aftershocks, and produced rare infrasound via ice flexing but reports of non-structural damage occurred, including household items falling from shelves and breaking. This event underlines the persistent seismic hazard in northern Mongolia, particularly along the Khuvsgul fault system and contributes to the understanding of intraplate seismic activity in the region and emphasizes the need for continued seismic monitoring in northern Mongolia.

INTRODUCTION

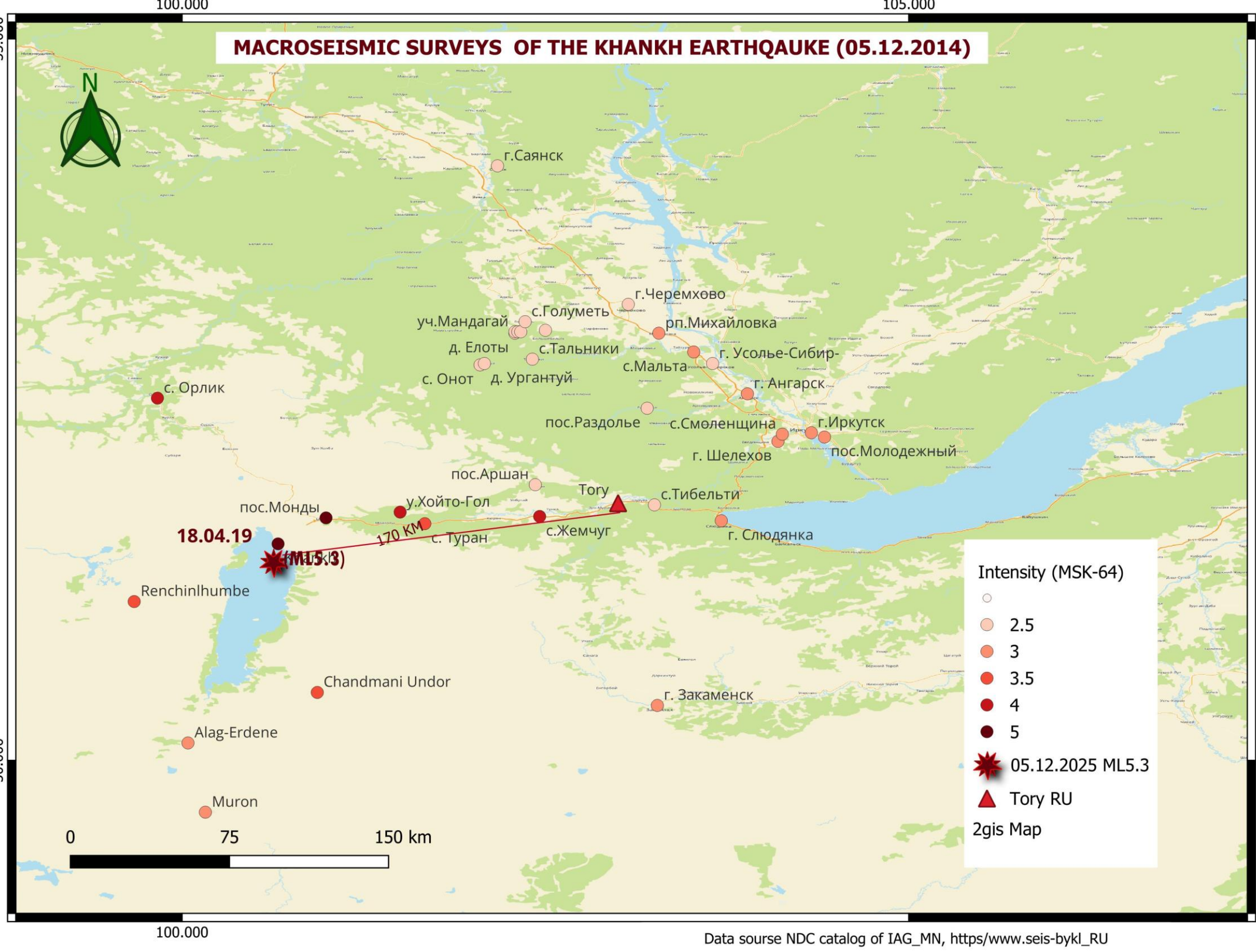
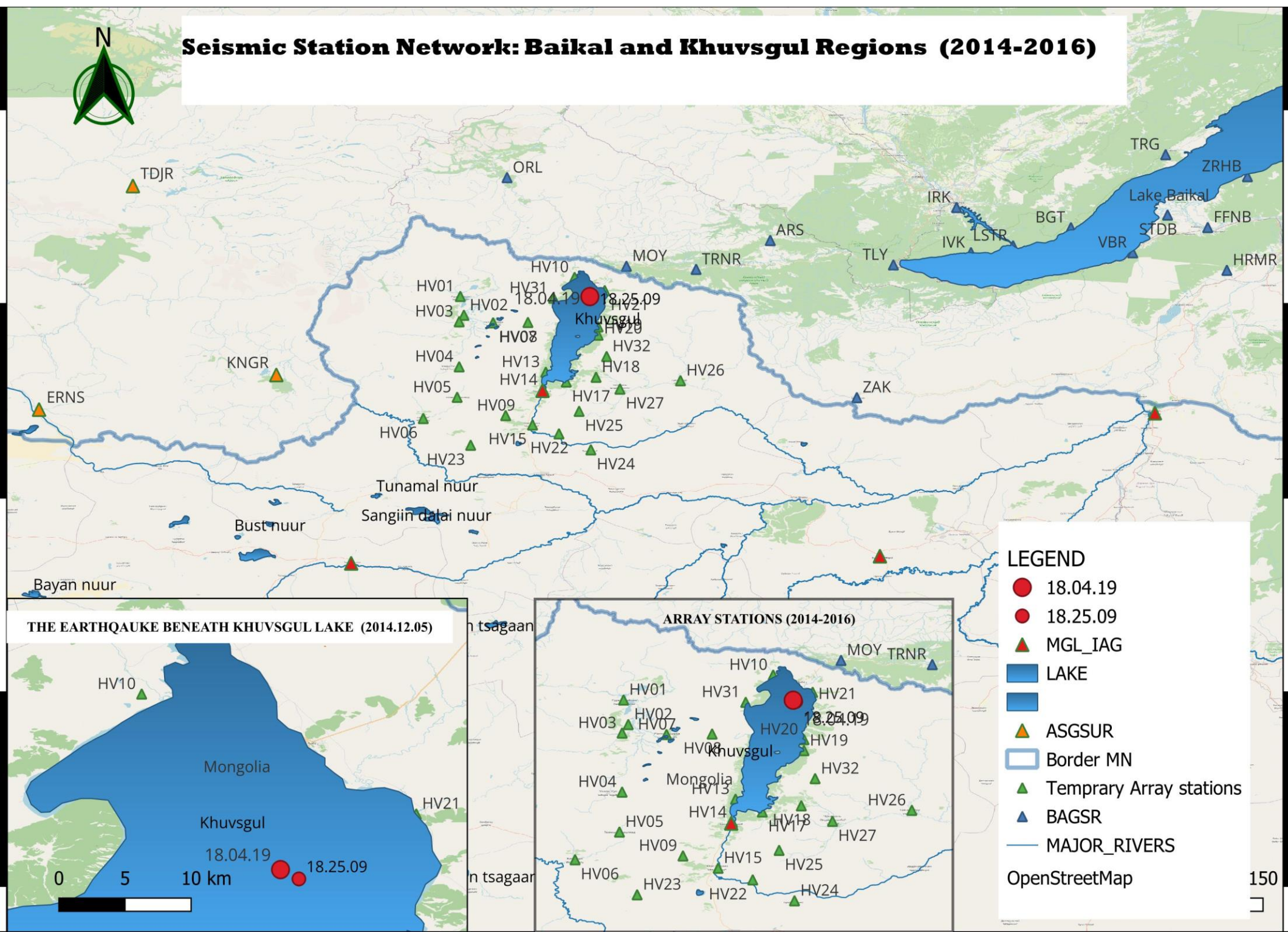
On December 5, 2014, an earthquake with a magnitude of (ML 5.3) occurred in the beneath of Khuvsgul lake of northern Mongolia. The event took place at approximately 02:04_06.12.2014 (Ulaanbaatar time) and was felt across northern Mongolia and parts of southern Siberia. The epicenter was located near the eastern side of Lake Khuvsgul, a region known for its active seismicity.

SEISMIC PARAMETERS OF THE QUAKE

Main shock:
Time: 2014.12.05_18:04:58 (UTC)
Location: Latitude 51.21 Longitude 100.36
Depth: ~10 km (swallow-focus)
Magnitude: ML=5.3
Energy class: K=13.9 (seis.bykl.ru)
Intensity in epicenter 5-6 MSK64
Location 15 WS Khankh village
Focal mechanism: reset
Fault type: Strike-slip
Infrasound duration ~140 seconds at Tory station

Aftershock: 2014.12.05_18:25:09
ML=4.5
There were no further strong tremors in the following days, and the epicenter did not cause significant aftershock activity.

Date	Lat°	Long°	Z	Strike	Dip	Rake	ML	Fit	ORID
12/05/2014_18:04:19	51.35	100.64	15070°	85°	10°		5.3	0.774	7514
12/05/2014_18:25:09	51.35	100.63	13060°	80°	-10°		4.5	0.7	7517



International agencies	t_0	δt_0	Hypocenter						Magnitude
	$\frac{min}{sec}$	c	φ°, N	$\delta\varphi^\circ$	λ°, E	$\delta\lambda^\circ$	h_c	δh_c	
IAG-MN	180418.01	0.2	51.49	0.02	100.65	0.02	10	—	ML=5.3
BYKL	180419.70	0.34	51.37	0.02	100.63	0.019	20–21*	—	$Kr=(13.9\pm0.2)/26,(Mw)^*=4.9/10$
MOS	180419.3	0.95	51.37	0.045	100.648	0.027	11	—	$MS=4.1/12,MPSP=5.1/11$
IDC	180418.48	0.48	51.32	0.119	100.69	0.105	0f	—	$mb=4.1/22,Ms=4.1/24$
NEIC	180421.75	1.84	51.28	0.091	100.697	0.114	16.5	4.3	$mb=4.9/112$
USGS_GCMT	180421.80	0.2	51.33	—	100.72	—	22.8	1	$Mw=5.0/119$
ISC	180421.1	0.49	51.457	0.029	100.792	0.042	11.2	3.08	$Ms=4.3/32,mb=4.8/127$
BJI	180418.3	—	51.55	—	100.67	—	11	—	$Ms=4.9/51,mb=4.5/5.2$

THE STUDY OF THE KHUVSGUL RIFT SYSTEM



Anne S. Meltzer, a seismologist known for her research on earthquakes and the formation of mountain ranges at Lehigh University. Meltzer's team (Mongolian and American researchers) was actively studying and monitoring the region Khuvsgul at the time. Their seismic array not only captured the Dec 5, 2014 ML 5.2 earthquake, but they also determined its depth, focal mechanism, and its structural association with the rift system. This work significantly advances understanding of intraplate lithospheric deformation and rift dynamics in Mongolia.

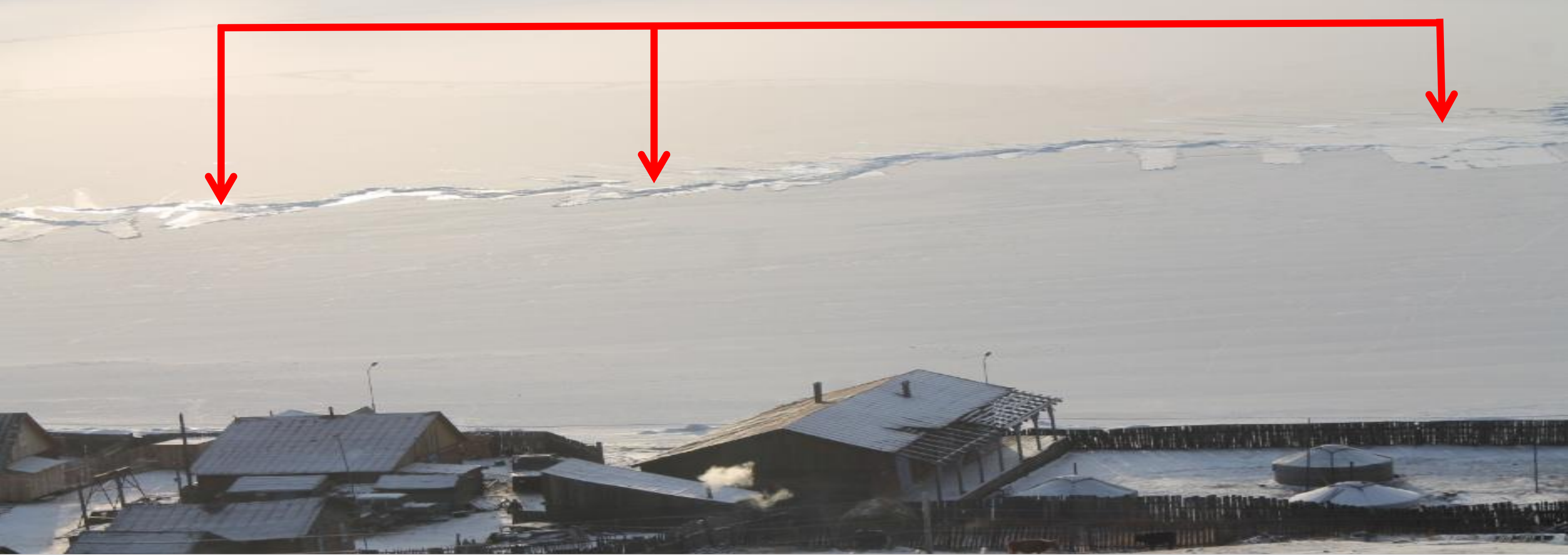


1.Focused Rift Deployment
Meltzer co-led a regional project deploying 26 broadband seismic stations over 200m² in the Khuvsgul Rift from August 2014 to June 2016.
2.Topography &Fault mapping
Utilizing finite-difference tomography, the team imaged a structurally 50 km-thick crust and pinpointed extensional faults (7–18km deep) on rift margins, alongside strike-slip activity beneath Lake Khuvsgul-including a Mw 4.79 quake in December 2014.
3. Newly Identified Active Faults
Analysis uncovered previously uncharted faults along the Darkhad Basin, highlighting the region's seismic complexity.




Insight Station Deployment 26 broadband seismometers in Khuvsgul rift (Aug 2014–Jun 2016)
Event Detection>2,100 local quakes;
largest: ML 5.3 on Dec 5, 2014 beneath the lake
Focal Mechanism Strike-slip with extension

THE EARTHQUAKE CASUALTIES



An ice crack caused by the earthquake



The earthquake's impacts in the Khankh governor's house

WHY THE 05.12.2014 KHANKH EARTHQUAKE WAS SPECIAL

- Detection by Infrasound**
A special feature of these earthquakes is the presence of an infrasound signal recorded by the Tory infrasound station (ISTP SB RAS), where a ~140 second long atmospheric wave detected in the Tory depression at a distance of 170 km from the epicenter of the Khuvsgul earthquake and its aftershock. First documented infrasonic record from this region
- Felt over a wide area**
The shaking was felt as far as Irkutsk, Russia, Murun Khuvsgul, and Ulaanbaatar, Mongolia
- Tectonic Importance**
This event highlighted hidden active faults.

CONCLUSION

The December 5,2014 Khankh earthquake was significant scientifically felt by instruments, triggered aftershocks, and produced rare infrasound via ice flexing but reports of non-structural damage occurred, including household items falling from shelves and breaking. This event underlines the persistent seismic hazard in northern Mongolia, particularly along the Khuvsgul fault system and contributes to the understanding of intraplate seismic activity in the region and emphasizes the need for continued seismic monitoring in northern Mongolia. Seismic waveform data recorded by the Mongolian Seismic Network (MSN) and international agencies such as the USGS and IRIS were used to determine source parameters. The event provides critical insights into crustal stress accumulation in northern Mongolia and contributes to ongoing regional seismic hazard assessments.

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