

What is the Central Asian Orogenic Belt? And Where are the Missing Metal Deposits?

or

An Explorationist's View of the CAO B

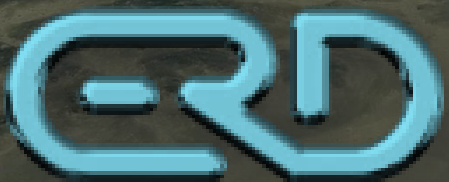
KHUNDII MINERALS DISTRICT GEO SYMPOSIUM

Ulaanbaatar - 18 September 2026

Presented by J. K. Cluer

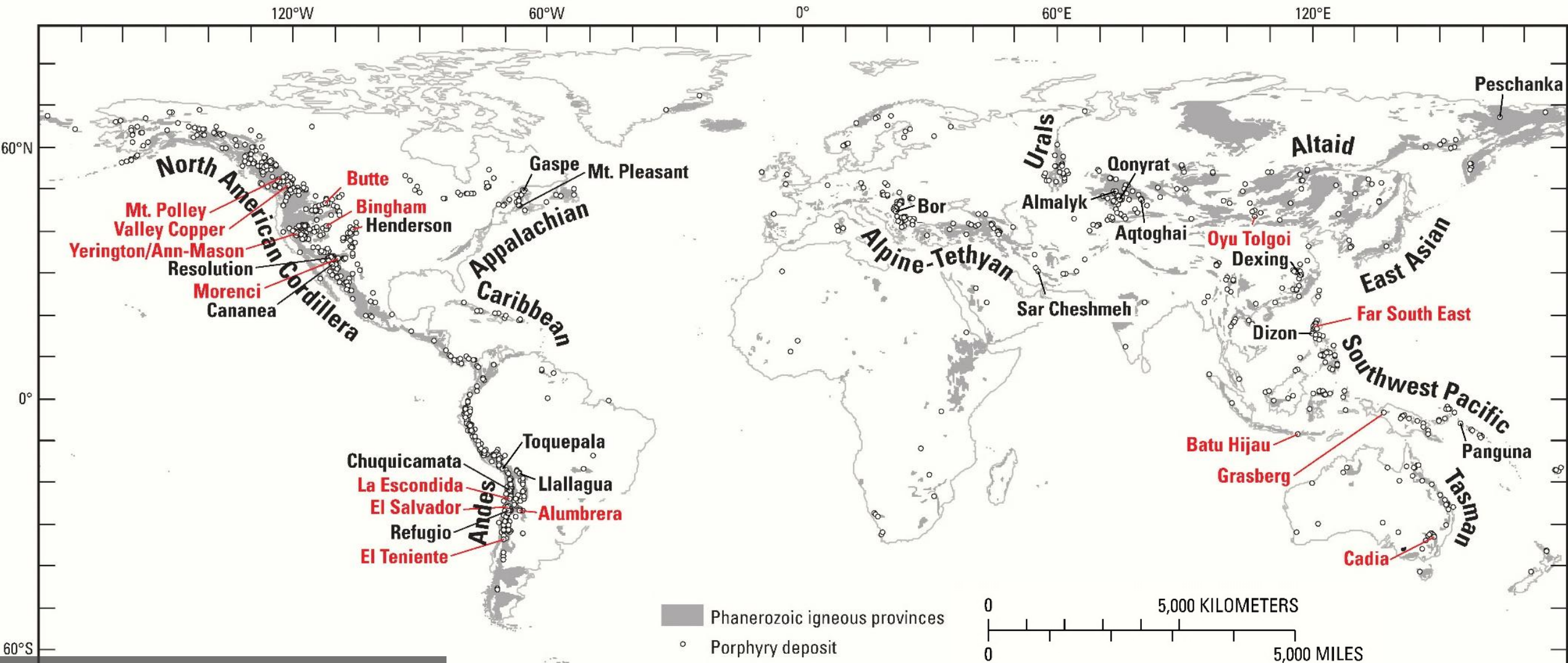


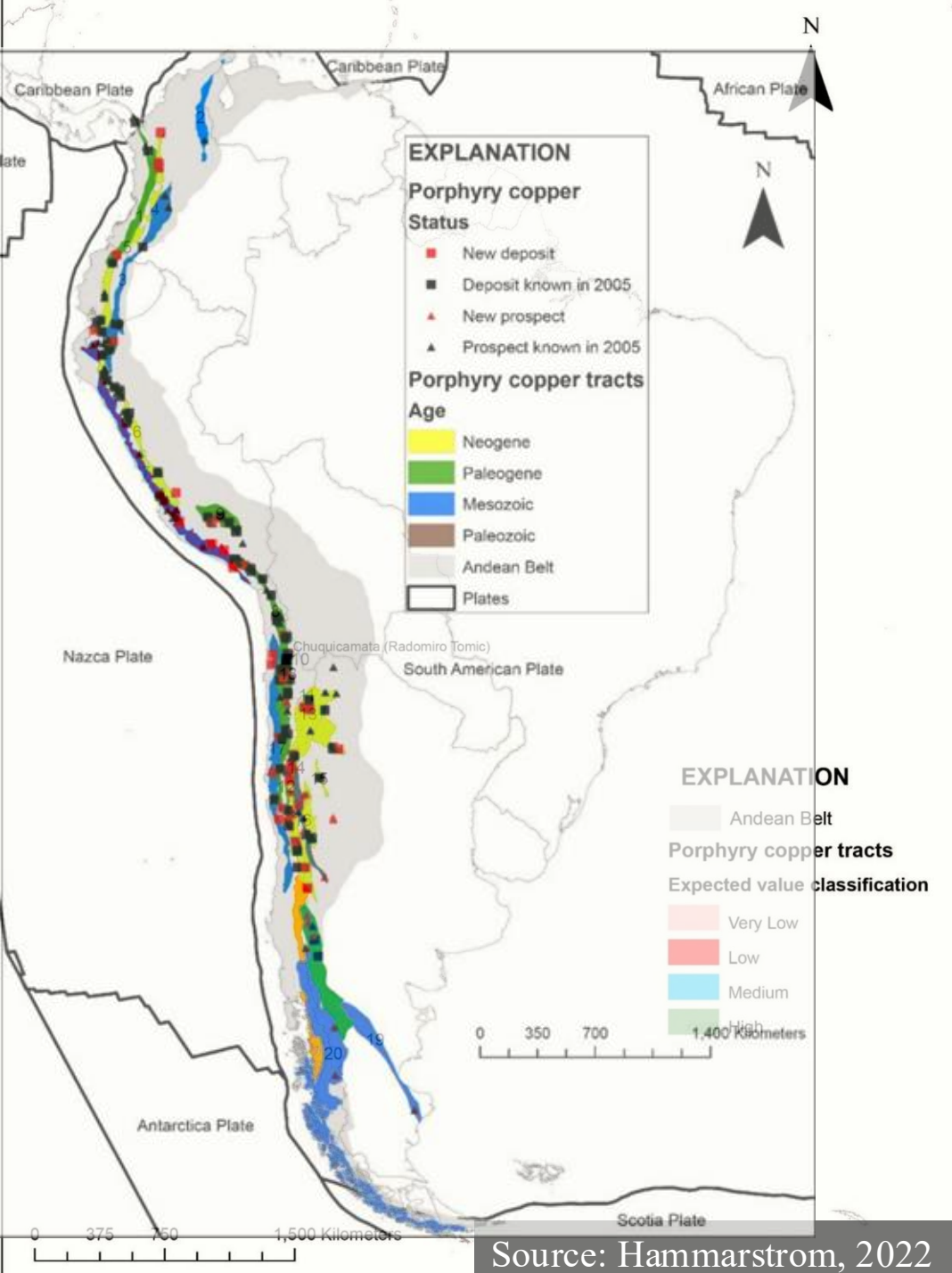
- ✓ We are going to look at the CAO B through one explorationst's eyes – me
- ✓ We will assess its exploration maturity
 - ❖ Explore-ability
 - ❖ Metallic discovery opportunities
- ✓ Discuss government actions and policies that can realize responsible resource growth in Mongolia



Level of geologic/geopolitical complexity

Exploration knowledge maturity





Source: Hammarstrom, 2022

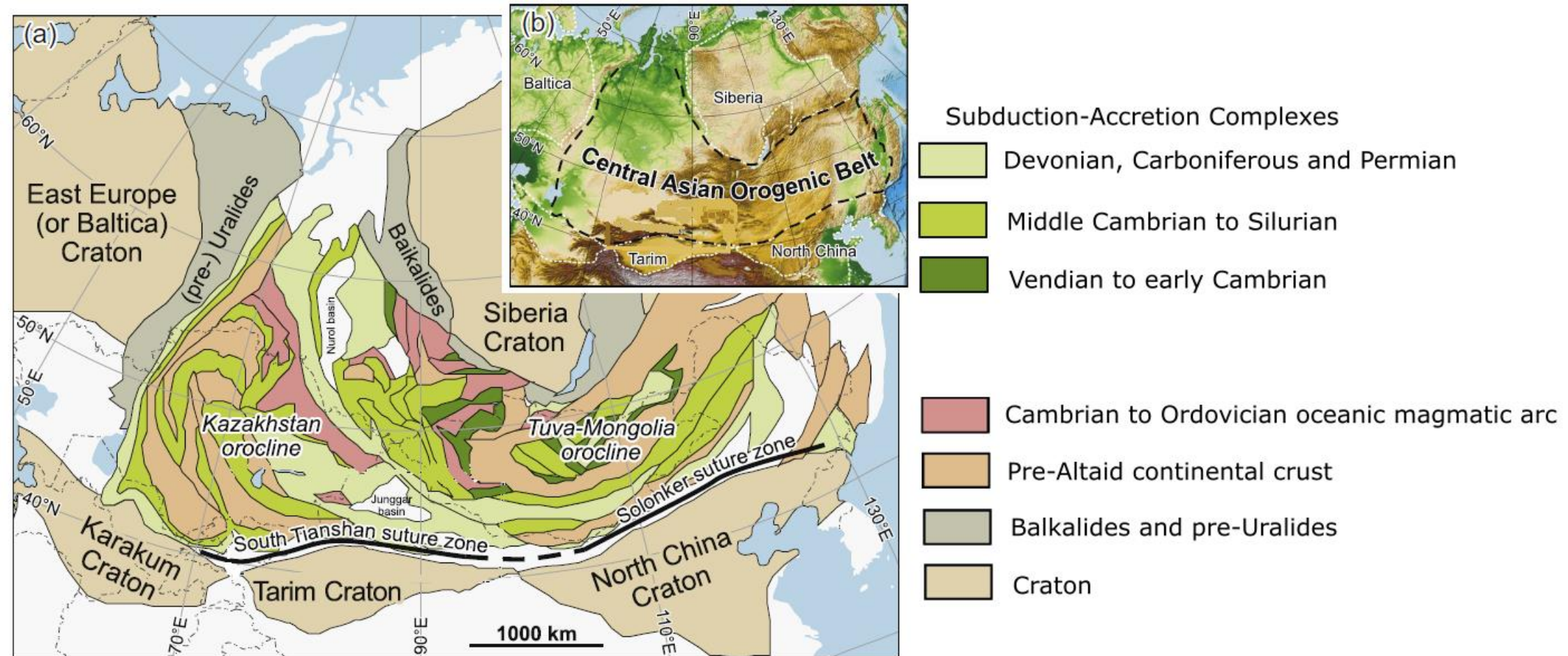
Metallogenic tract maps with ranked prospectivity, based on systematic and unified research efforts, usually government agencies.

Helpful guides to estimate overall metal endowment and undiscovered resources.

Explorationists should be aware of such tools, understand how they are built, and also be ready to challenge them with new ideas and concepts.

We are not at this level in the Central Asian Orogenic Belt:

- **Considerable scope for collaborative G2G research and basic data acquisition**
- **Research partnerships with industry where new exploration licenses are available will lead to new discoveries**



Source: Han and Zhau, 2017

Does this look more complicated and difficult to explore than the Andean belts?

Most of the largest and most important metal deposits (excluding REE giants) formed in a window approximately 410-200 Ma, typical orogenic time frame



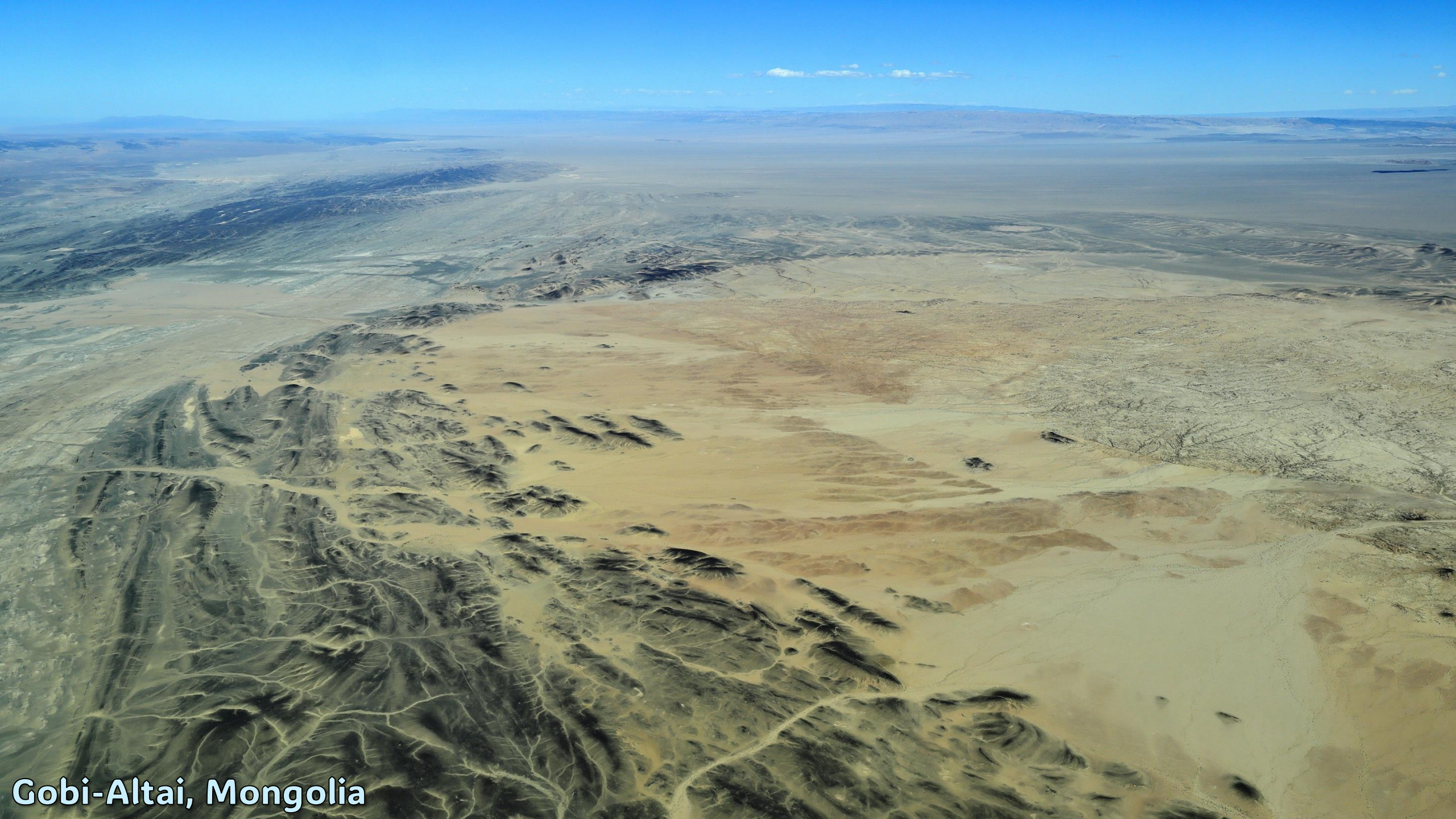
Northern Urals, Russia



Southwestern Steppe, Kazakhstan



Tien Shan, Kyrgyzstan



Gobi-Altai, Mongolia



The Central Asian Orogenic Belt is largely contained within Russia, Kazakhstan, Uzbekistan, China and Mongolia; with smaller tracts through Kyrgyzstan and Tajikistan.

What kind of metal deposits were sought during intense Soviet exploration campaigns?

What areas were overlooked during the Soviet era?

What countries have been most open to modern exploration, for a sufficient amount of time?

What is the level of exploration maturity?



What tracts have high metal system preservation potential; i.e., regions of “soft collision” and minimal uplift?



What exploration surveys have been completed at sufficient extent, detail and quality? *(and made publicly available)*



What is the optimal exploration survey mix for each terrain/deposit type?

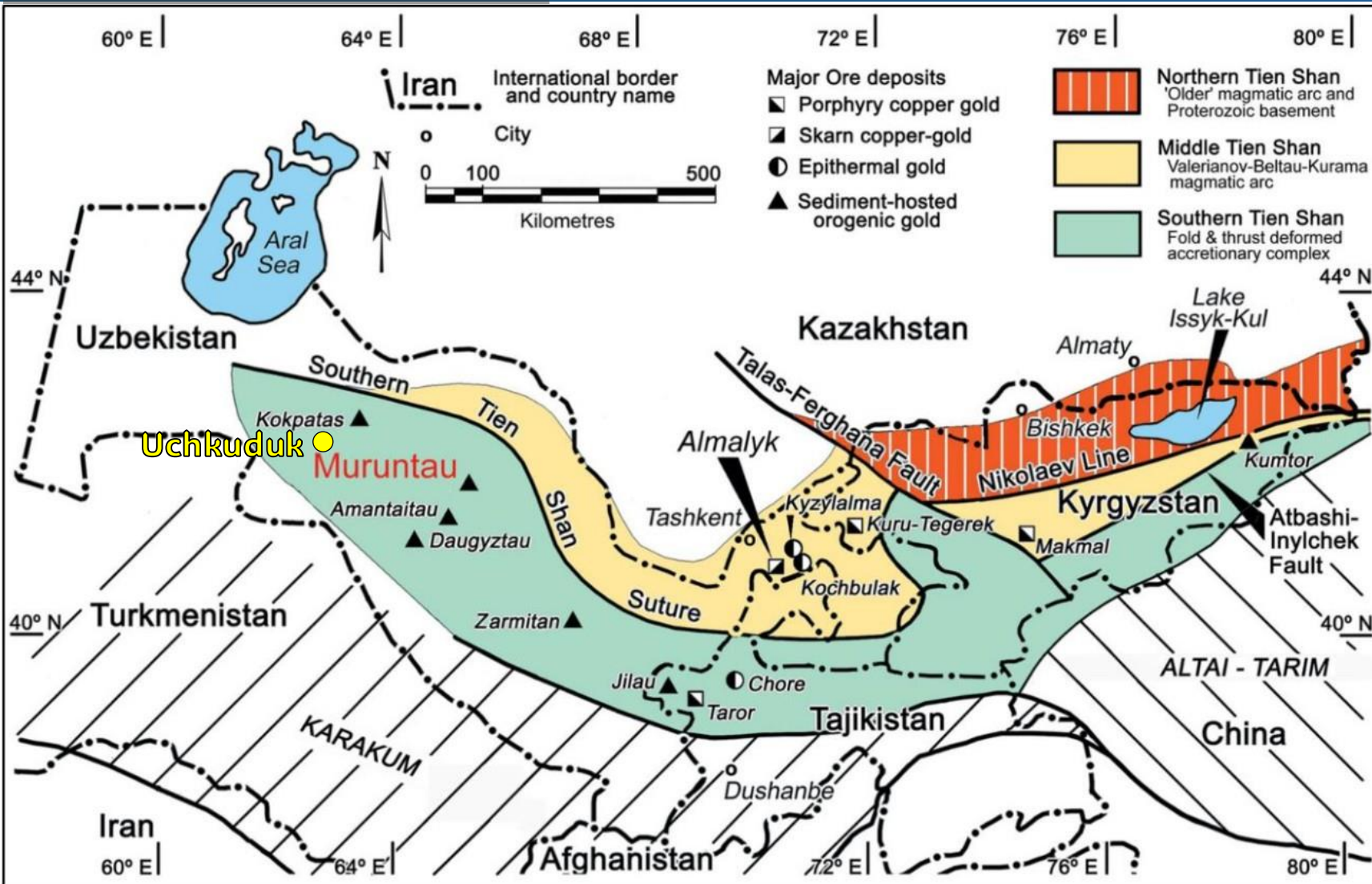


What government licensing, regulatory and support institutions are in place to assure new discovery and development success?

Uzbekistan – An Emerging Exploration Frontier?



Modified from Seltnann et al., 2020



DIVERSE TIER-1 ASSETS

- **Muruntau** – orogenic gold
~100 Moz I+I
288 Ma (230-300 Ma magmatic window)
- **Almalyk-Kalmakyr** – porphyry copper(Au+Mo) cluster Yoshlik super-pit design contains 17 Gt @ 0.26% Cu + 0.34 g/t Au → 5,720 t Au (185 Moz)
~306-313 Ma
- **Uchkuduk region** – sandstone + breccia uranium
300,000 t U₃O₈
(prod+resources) recently re-energized under Orano JV

The Muruntau deposit was discovered in 1958 and has been in operation since 1967

Past production to 2024 is estimated at ~700 Mt @ 2.32 g/t for 52.3 Moz gold

Audited Mineral Resource Statement for the Muruntau Cluster
Wardell Armstrong International, effective January 1, 2024

Deposit	Class	Tonnes (Mt)	Au Grade (g/t)	Contained Au	
				(Moz)	(t)
Muruntau	<i>Indicated</i>	2,016	0.93	60.0	1,866
	<i>Inferred</i>	732	0.81	19.1	595
	Total	2,747	0.90	79.1	2,461
Mutenbai	<i>Indicated</i>	230	1.06	7.8	244
	<i>Inferred</i>	491	0.91	14.3	445
	Total	721	0.96	22.2	689



PorterGeo Database - Ore Deposit Description

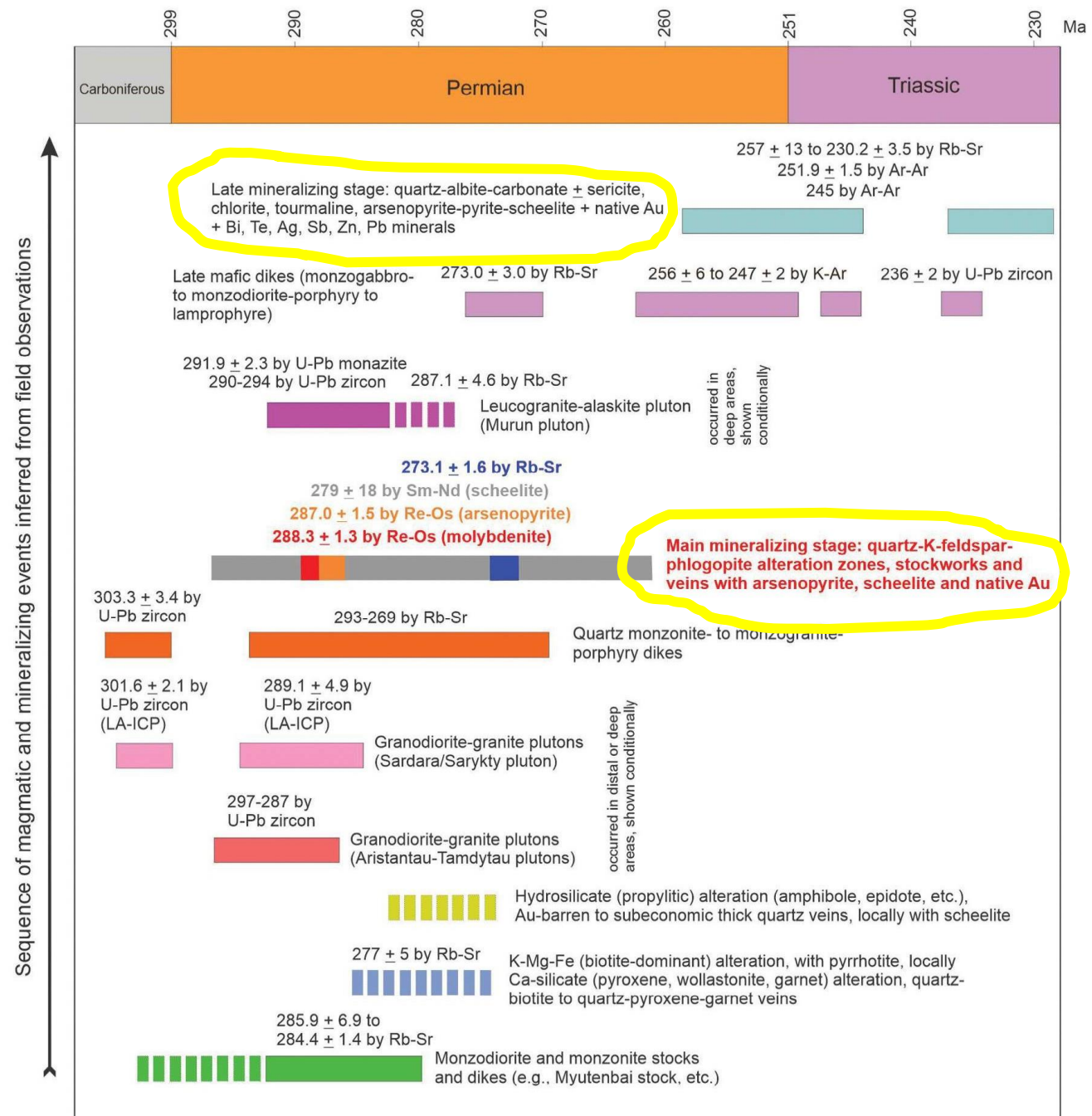
Resource and Reserve statements from:
Wardell-Armstrong, 2024, JSC Navoi Mining and Metallurgical Company, Mineral Resources Audit and Ore Reserve Estimate, Muruntau Cluster Gold Deposits, Uzbekistan
[combined-mre-ore-report-final-v2-en.pdf](#)

Southern Tian Shan Suture

Zone of oblique collision, subduction and accretion resulting in complex fold and thrust terrane involving Ordovician through Carboniferous marine siliciclastic strata, overlain by globally typical Devonian carbonate successions (strat+thrust).

The Besapan Suite (O-S) hosting Muruntau is the chronostratigraphic equivalent of the major host strata for Nevada's Carlin systems.

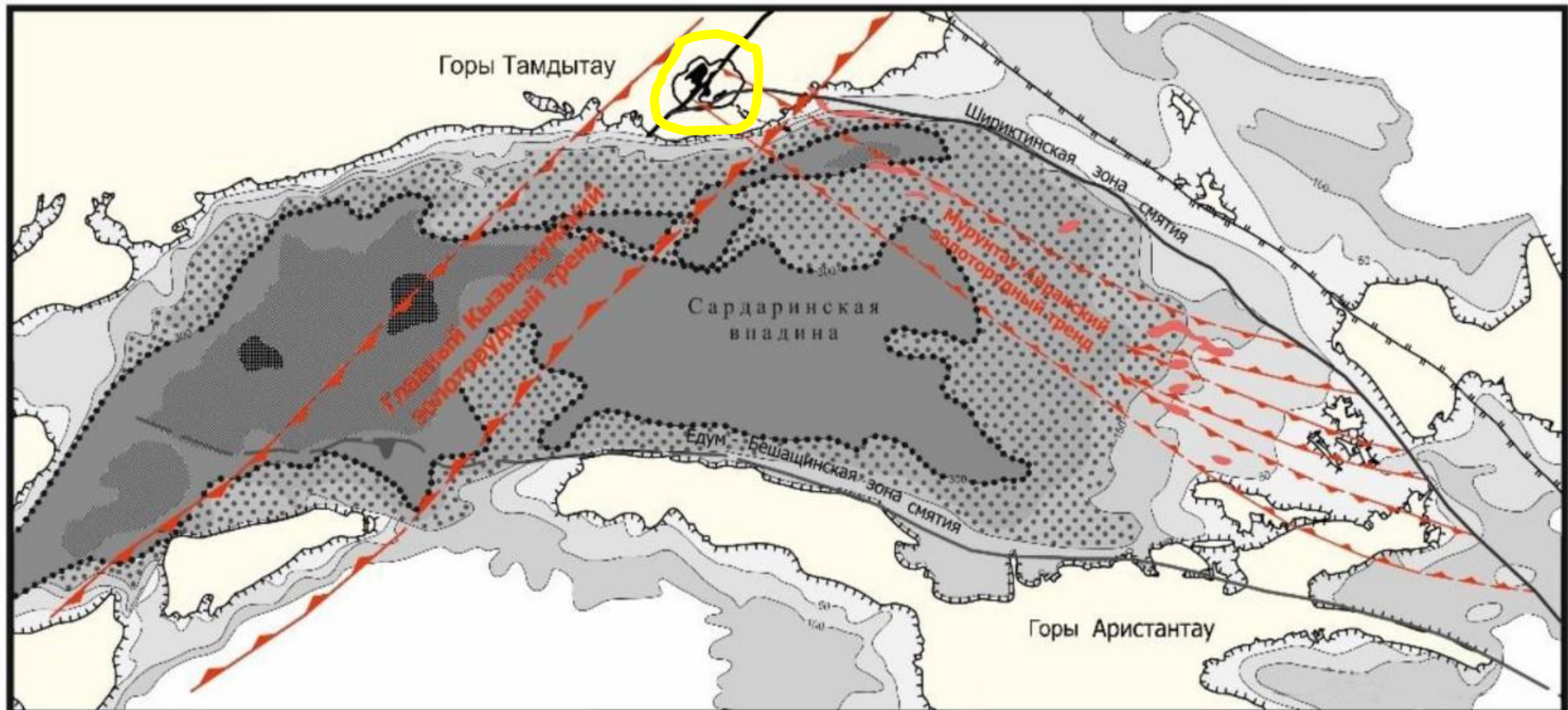
~70 Ma window of post orogenic magmatism and episodic gold mineralization over ~ 30 Ma.



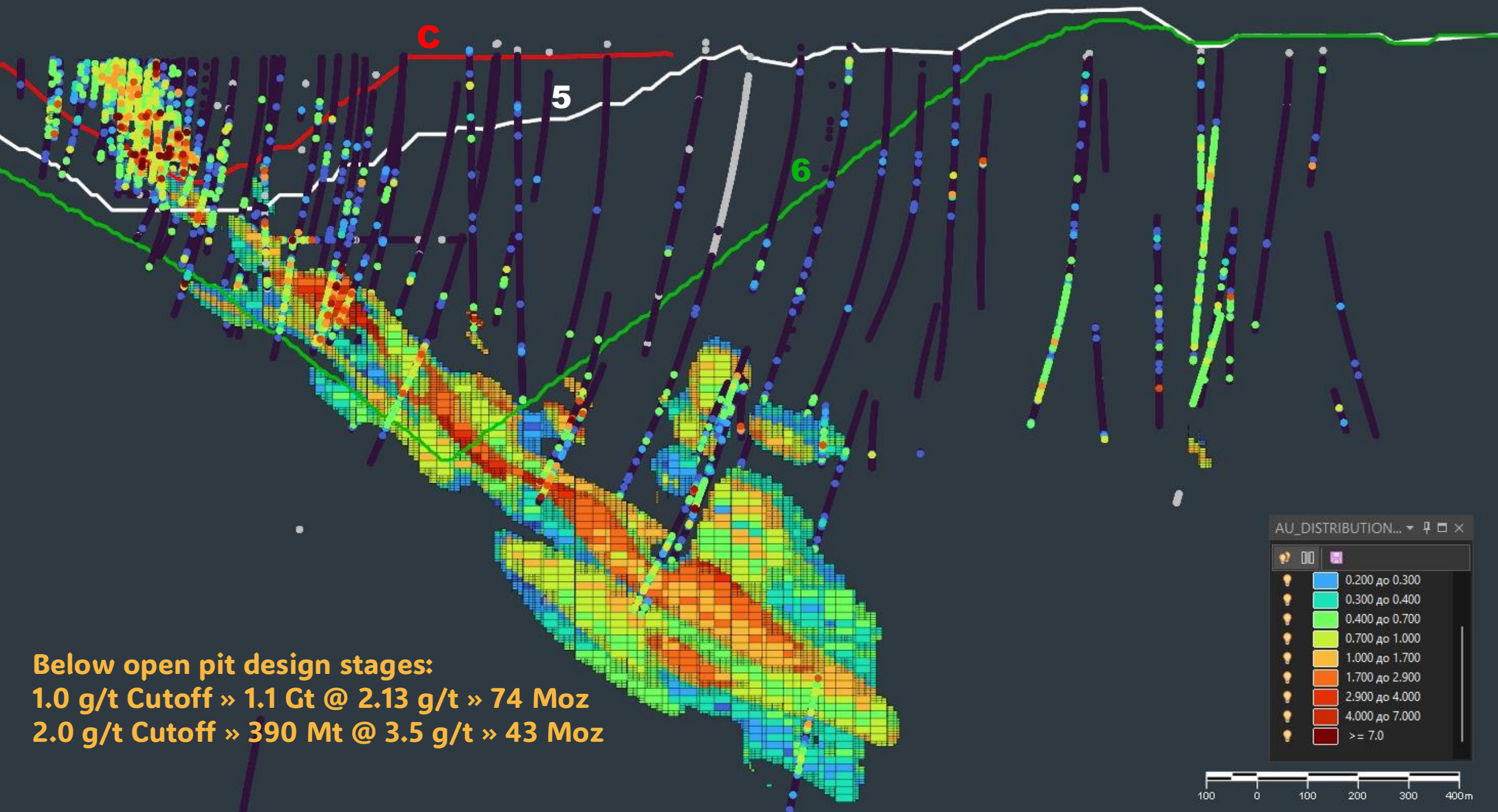
Major Gold Trends of Kyzylkum Region



Main Kyzylkum Trend (NE direction) and
Muruntau-Airak Trend (NW direction) intersect at Muruntau



Modified from
Antonov, 2024



Below open pit design stages:

1.0 g/t Cutoff » 1.1 Gt @ 2.13 g/t » 74 Moz

2.0 g/t Cutoff » 390 Mt @ 3.5 g/t » 43 Moz

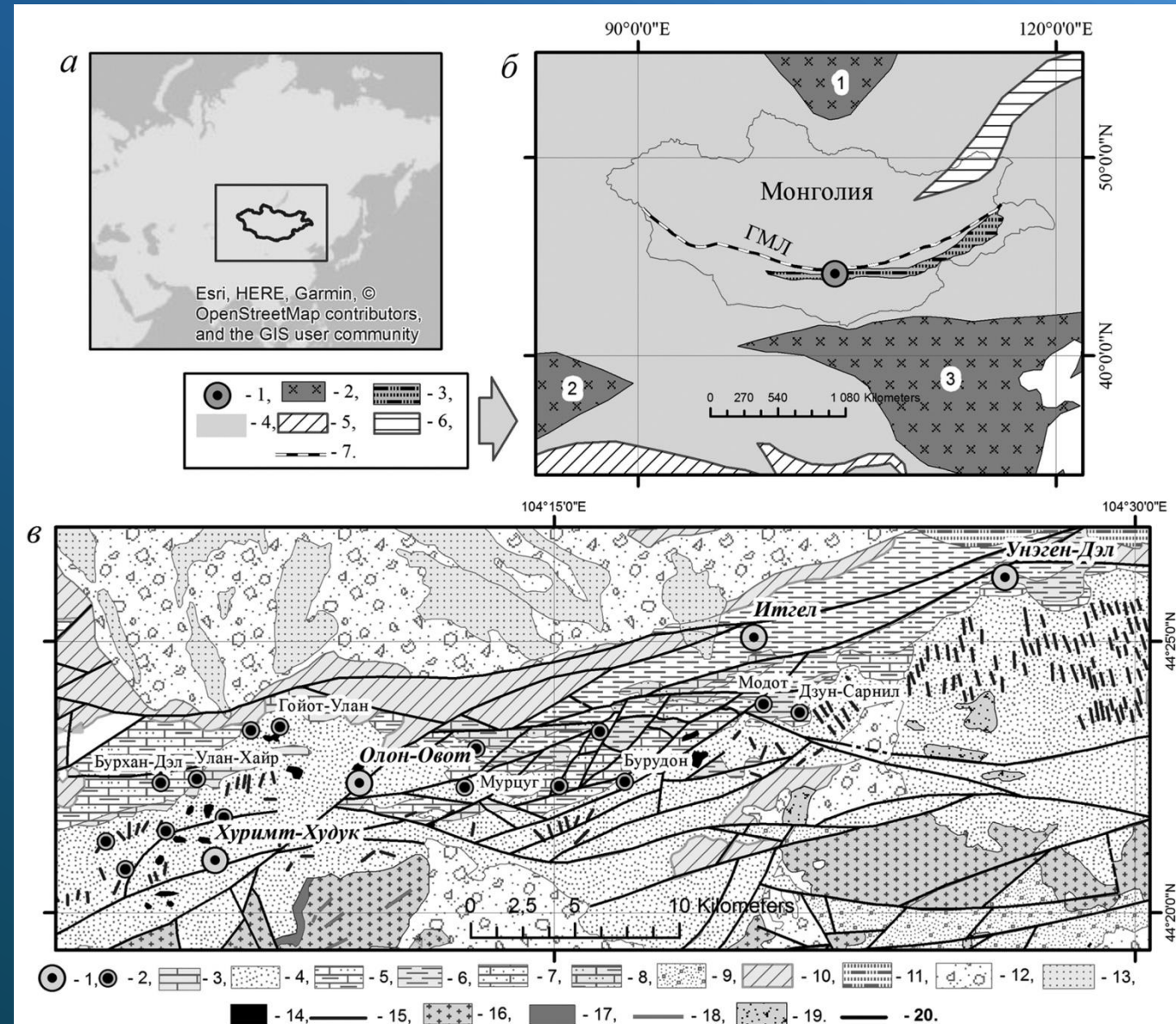
OLON OVOOT, Permian orogenic Au deposit in South Gobi cluster

283 +/-4 Ma on muscovite of main Au stage (Bayanjargal, M.Sc. Thesis)

Hosted in highly deformed, moderately metamorphosed lower Silurian sandstone and shale, intruded by early Permian granite and Devonian mafic dikes (Mandal-Ovoot terrane)

Approximately 40t Au in quartz-carbonate-tourmaline veins and sulfide disseminations

CAOB in Mongolia is permissive for large orogenic Au deposits. Where are they? Is anyone looking?



Source Zadorozhnyy et al., 2019

Orogenic belts the world over have a common theme: the longer the magmatic activity persists, the greater the metal endowment.

CAOB metallogenesis spans from middle Paleozoic (Urals) to early Jurassic – several HUNDRED Ma

SW USA porphyry belt extends from Late Cretaceous to early Oligocene (~75-33 Ma)

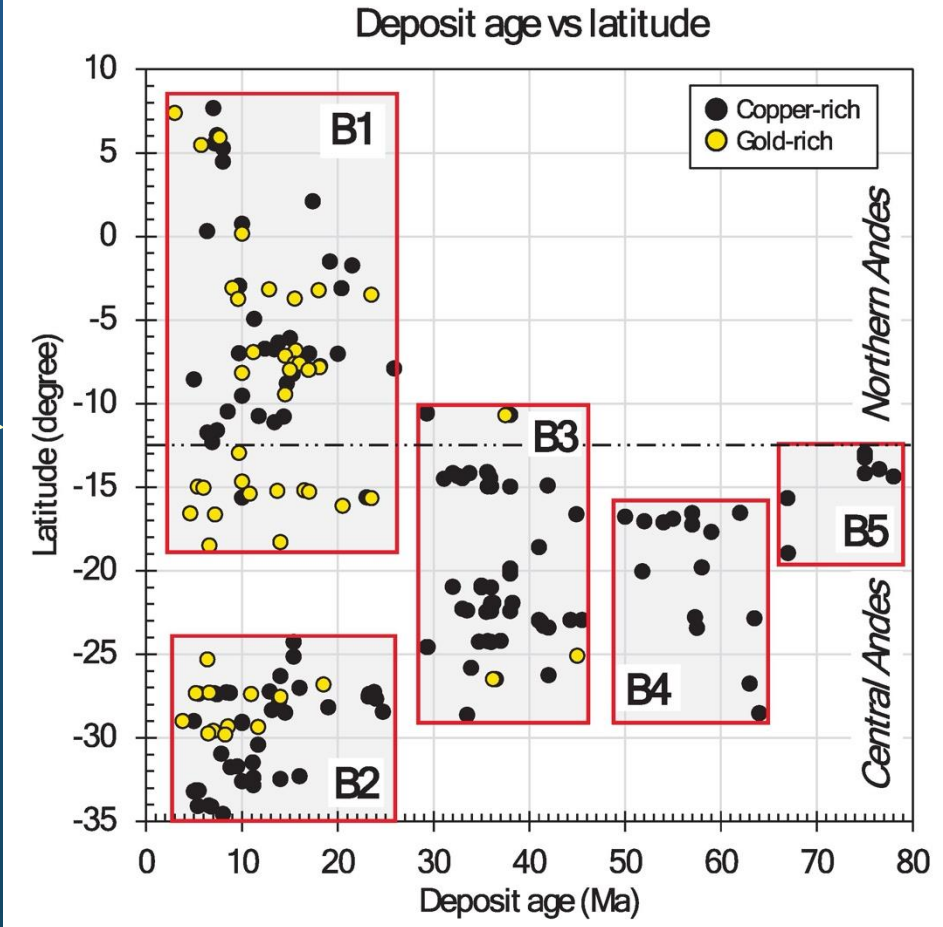
Andean PCDs formed mainly during ~78 to 3 Ma

The largest Carlin Gold systems have a Jurassic through Eocene magmatic history, approximately 110 Ma long, even though the main stage gold spans a relatively short time

Effective exploration requires pursuing regions with long metallogenic spans and not getting too focused on individual ages and single age dates for large deposits; their history is usually more complex:

»» *endowment ≈ time*

O. Rabbia



Source: Rabbia, 2026

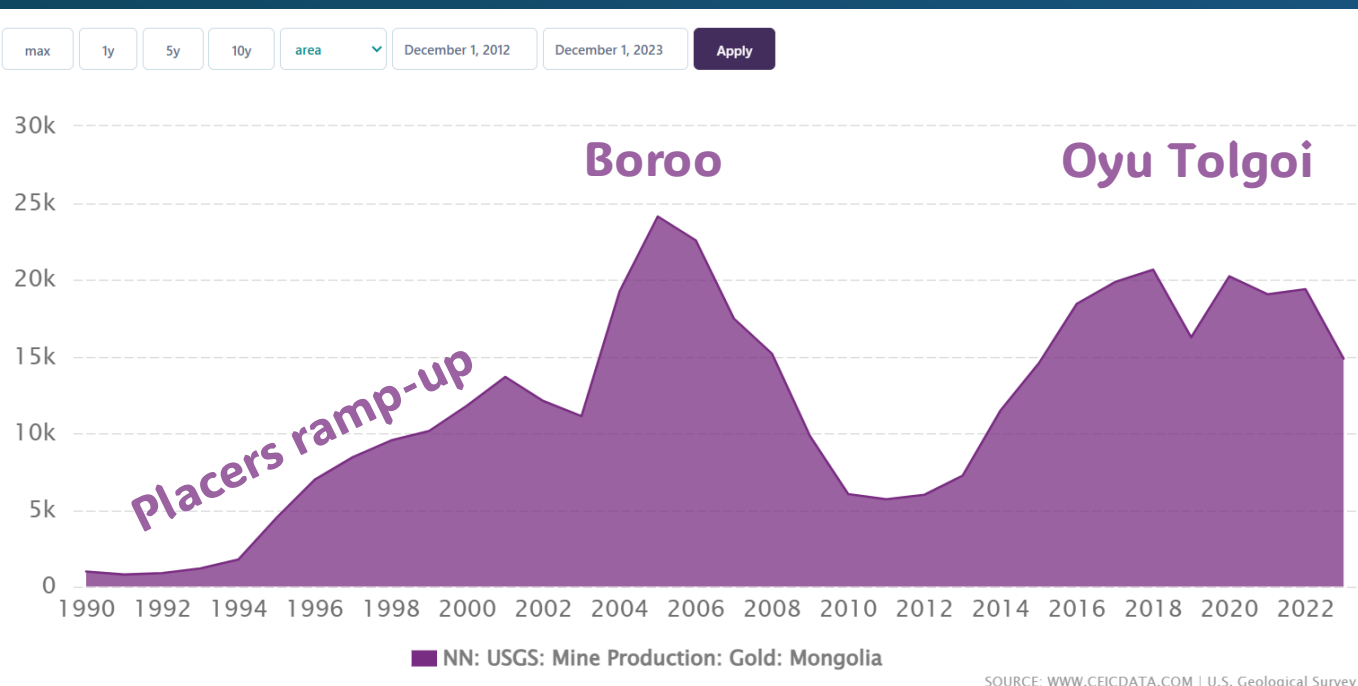
LIFE CYCLE OF A GOLD PROVINCE

Current mines and pipeline of development projects suggests Mongolia can attain and sustain ~25t Au/yr for the next ~20 years

New discoveries and process centers are required to raise the production profile

Mongolia has the geology to support significant resource expansion and production growth

- *This will require innovation and openness in licensing system and regulatory/taxation regime – all achievable with stakeholder alignment and a will to succeed*



Oyu Tolgoi, Bayan Khundii, Bayan Airag, Khan Altai, Kharmagtai, others



Congress Should Fund the Earth Mapping Resource Initiative

The [Earth Mapping Resource Initiative](#) (Earth MRI) accelerates the development of domestic critical mineral resources by collecting and providing industry with geologic data. The [Infrastructure Investment and Jobs Act](#) formally established Earth MRI within the U.S. Geological Survey and provided \$64 million of annual funding through FY26.

Earth MRI Pays for Itself

Funding for Earth MRI is an [investment](#)—not an expense. Mapping programs in competing countries consistently show positive returns on public spending from increased tax revenue. Many of the fiscal benefits materialize in the near term as the geologic data stimulates industry to invest in additional mineral exploration and eventually full-scale mining operations.

Public Mapping Program	Tax Revenue per Dollar Spent	Investment per Dollar Spent
Exploration for the Future (Australia, federal)	\$14	\$53
Exploration Incentive Scheme (W. Australia)	\$9.9	\$10.1
National Geological Program (Chile)	\$11.5	<i>not available</i>
Plan for Accelerating Exploration (S. Australia)	\$48	\$14
Targeted Geoscience Initiative (Canada)	<i>not available</i>	\$4.5

<https://thebreakthrough.org/issues/energy/congress-should-fund-the-earth-mapping-resource-initiative>

Nations that invest wisely and transparently in Resource Initiatives are capturing the benefits.

Is Mongolia ready to join its peers in this investment opportunity?

When all stake holders are aligned and collaborate closely with clear and achievable goals, Mongolia’s mineral resource foundation will grow.

What additional steps can be taken to make it happen?

Thank you for attending!

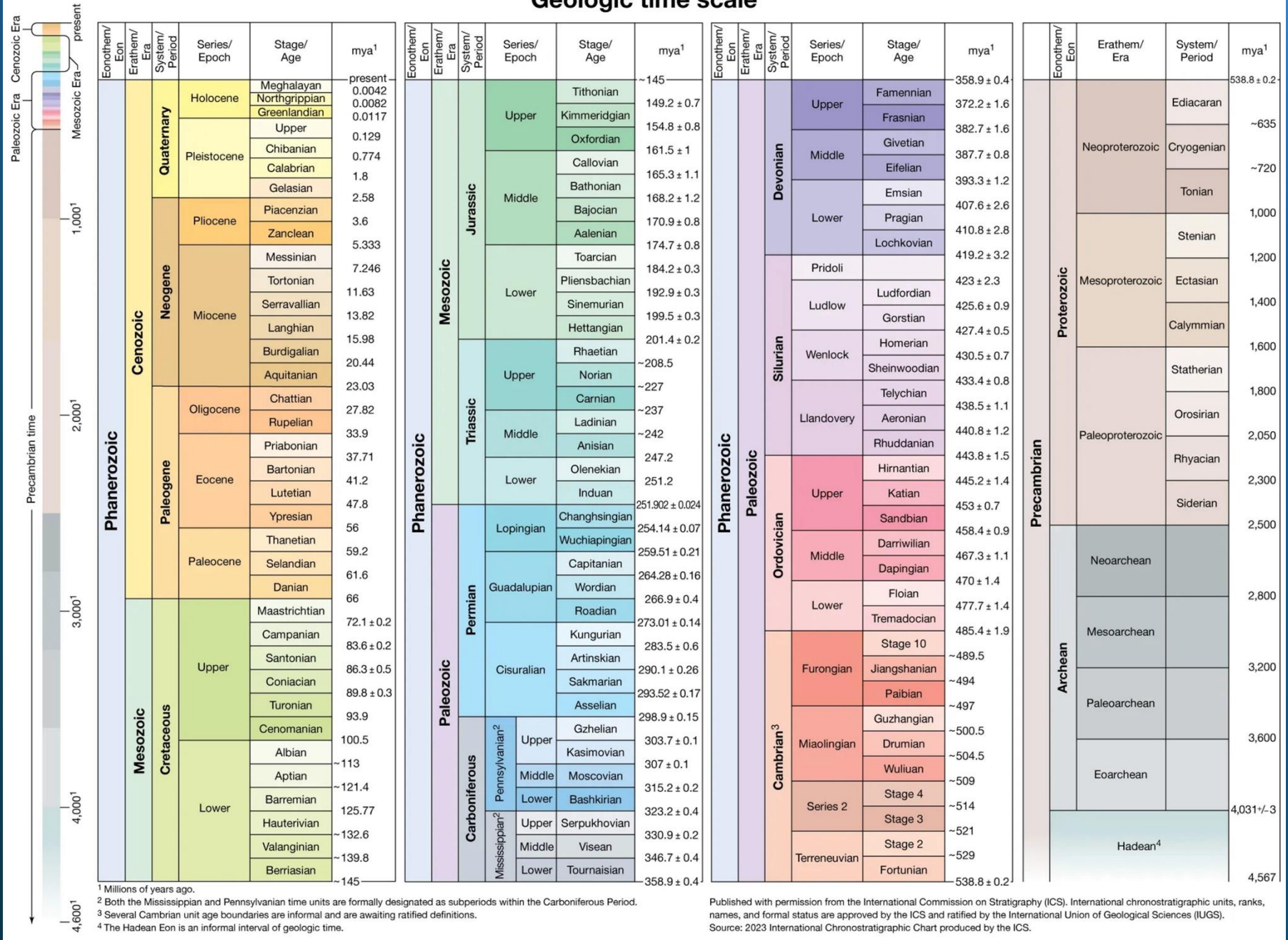
Let's start exploring, seriously!

Terminal Triassic to Early Jurassic subduction-related orogenic Au systems are common in northern Mongolia:

- **Boroo – 60-80 t Au, half at >3 g/t**
- **Gatsuurt – perhaps up to 200 t Au, most at high grades – 3-8 g/t**
- **Source of Zamaar placer fields - >150 t Au**

And they are broadly co-eval with Mo-rich porphyry systems (i.e., Erdenet cluster)

Geologic time scale



BANDICAM ADMIN PERSONAL

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Домой Основные Видео Изображения О программе

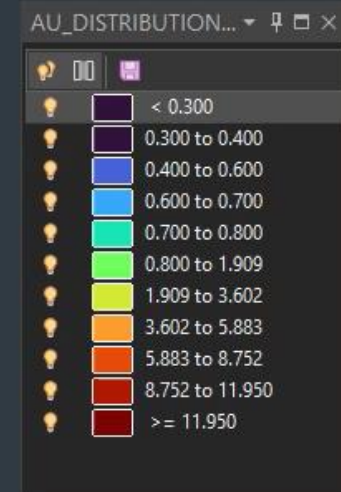
Начало работы | **Видео** | Изображения | Аудио

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Сортировка по дате

Открыть Править Загрузить Удалить



1 km



ENE looking grade sections

