

OLLI SG 497

Ancient DNA

Session 4 - October 19, 2022

Recap

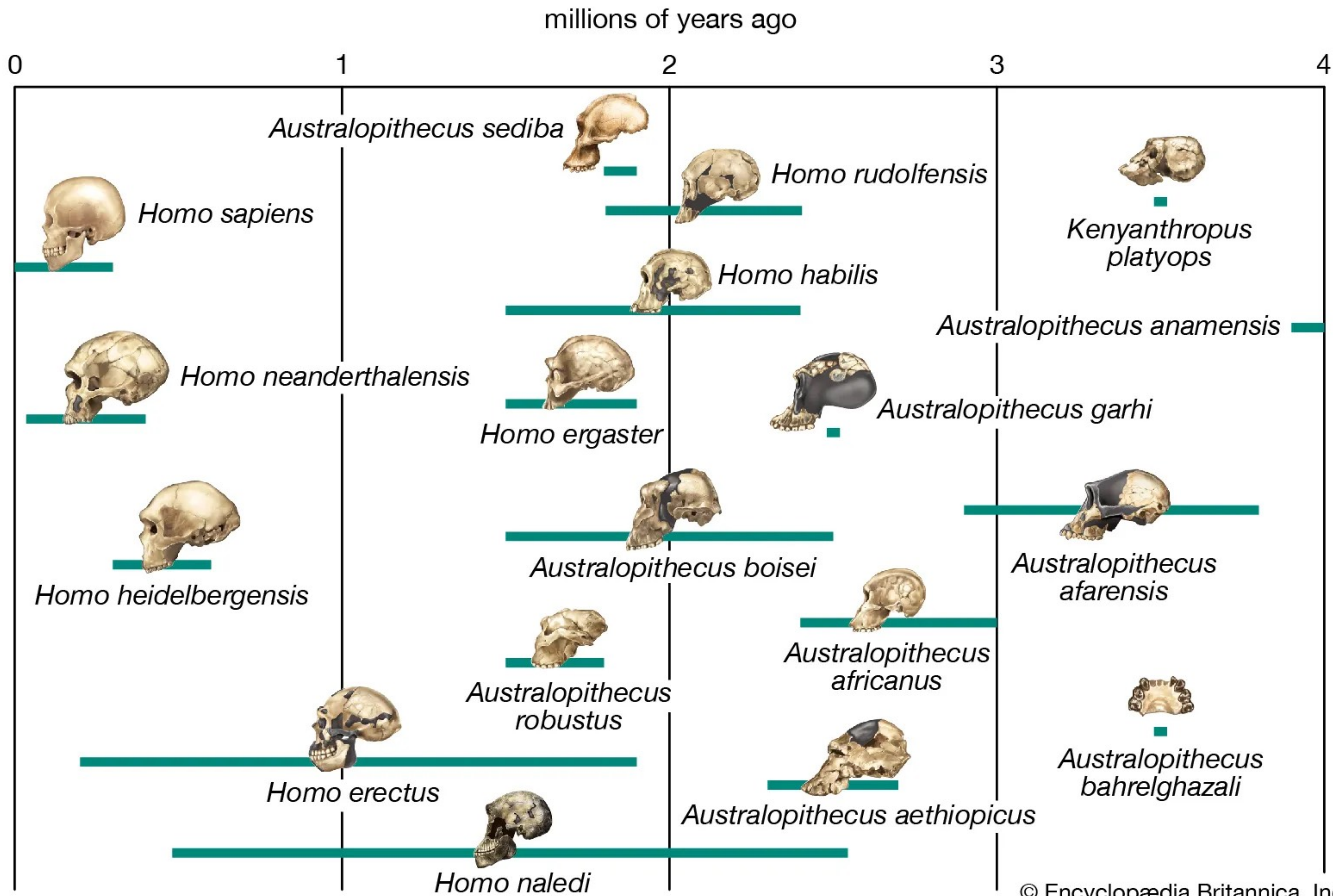
- No “Mitochondrial Eve”, no “Y-Chromosome Adam”. One hundred thousand Adams and Eves.
- Population “bottleneck event” for early modern humans that persisted for a long time.
- Proof that Neanderthals and modern humans interbred, especially in Near East.
- Reasons why we have so little Neanderthal DNA in our contemporary human genomes.

Today's Meeting

- Denisovans
- Denisovans and New Guineans
- Hypothesis of Australo-Denisovans
- Ancestor of Neanderthals and Denisovans
- “Superarchaic” humans - a “ghost” population
- Eurasia as a hothouse for human evolution - migration **into** Africa

Human Evolution

The Fossil Record



Denisovans

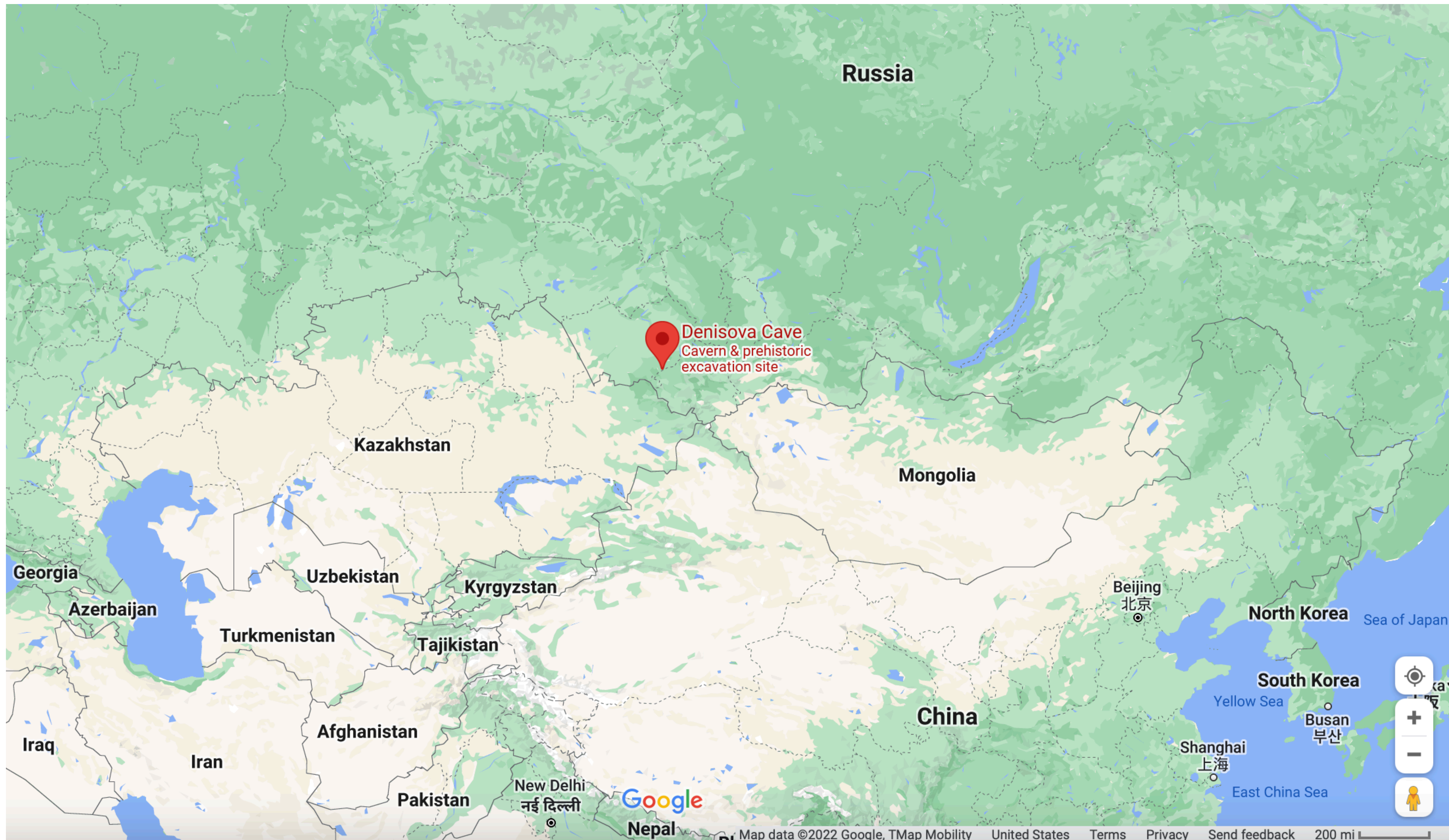
- In 2008, a finger bone fragment (and a molar) of an unknown archaic human were discovered in Denisova Cave in southern Siberia near the Altai Mountains.
- A portion of the finger bone was sent to Svante Paabo's lab for analysis.
- No archaeological artifacts were found.
- Archaeologists named the find *Homo Altaiensis*, a new human species.
- Reich's team used the neutral term "Denisovans"; not sure it was a new species.

Denisovans

Denisova Cave



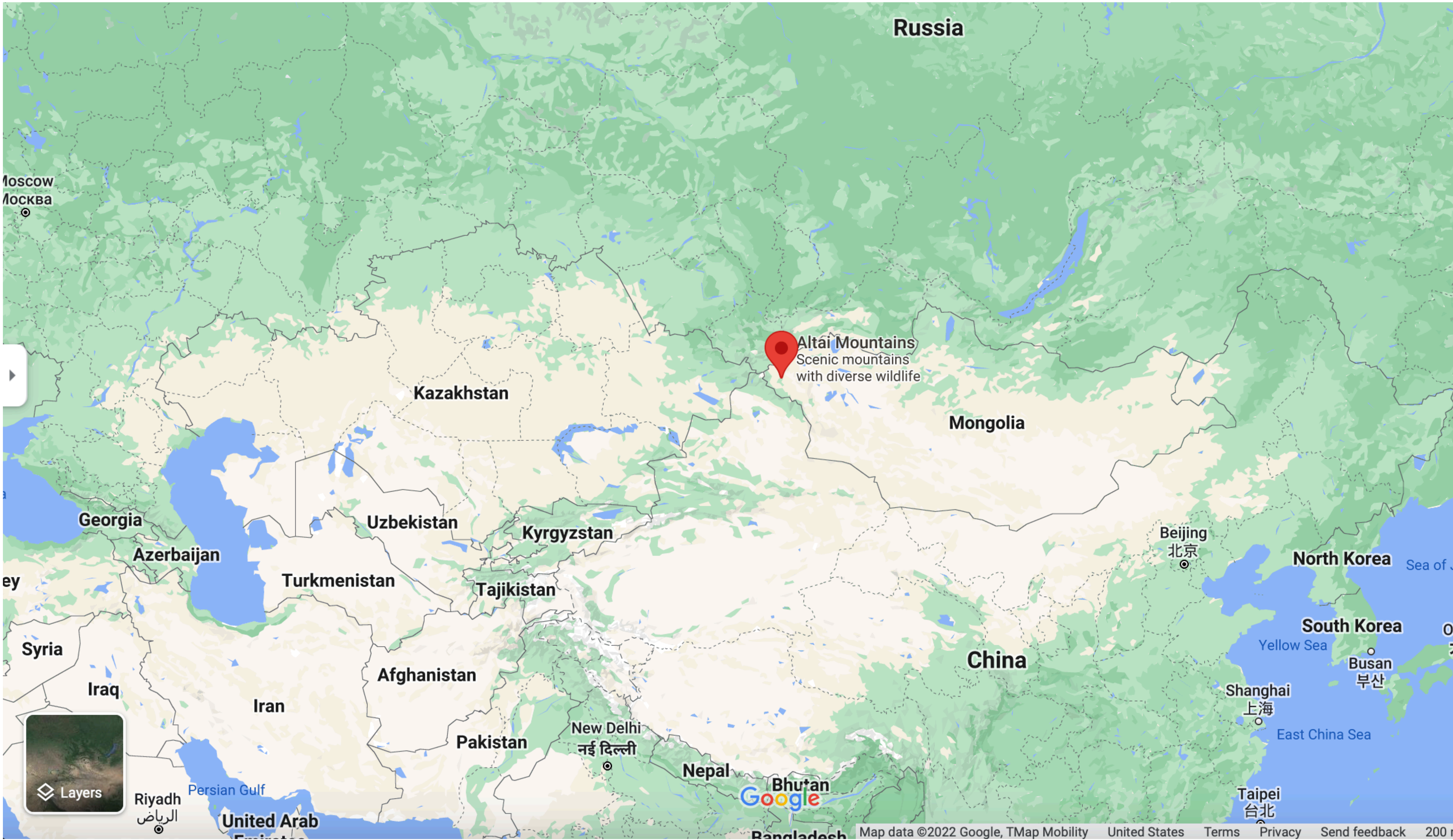
Denisova Cave



Denisova Cave
Cavern & prehistoric
excavation site



Altai Mountains



Denisovans

Findings From DNA Analysis

- Analysis of mitochondrial DNA:
 - 400 differences between Denisovan mtDNA and the mtDNA of present-day humans and Neanderthals.
 - Estimated to have separated from the lineage leading to present-day humans 800,000 to 1,000,000 years ago.
- Analysis of whole genome:
 - Neanderthals and Denisovans were more closely related to each other than either was to modern humans.
 - Separation between Neanderthal and Denisovan ancestral population occurred 470,000 to 380,000 years ago.
 - Separation between both these archaic groups and modern humans occurred 770,000 to 550,000 years ago.
- Denisovans were cousins of Neanderthals

Denisovans and New Guineans

Relation to Present-day Populations

- Denisovans were genetically a little closer to New Guineans than to any other population from Eurasia.
- This suggests that Denisovans interbred with New Guinean ancestors.
- Several issues needed to be resolved about the interbreeding:
 - The distance from Denisova Cave to New Guinea is around 9000 kms./5400 miles.
 - There is a large climate difference between the harsh, wintry climate of Siberia and the tropical climate of New Guinea.

Denisovans and New Guineans

Relation to Present-day Populations

- Dilution of archaic DNA resulting from recombination - the issue of the length of the residual ancestry segments - Denisovans longer than Neanderthals:
 - The length of Neanderthal segments in New Guineans corresponds to interbreeding between 54,000 and 49,000 years ago.
 - The length of Denisovan segments in New Guineans corresponds to interbreeding between 59,000 and 44,000 years ago.
- 3 to 6 percent of New Guinean ancestry derives from Denisovans. 2 percent derives from Neanderthals.
- 5 to 8 percent of New Guinean ancestry comes from archaic humans.

Denisovans and New Guineans

Location of the Interbreeding

- Largest amounts of Denisovan ancestry in indigenous populations in the Philippines, New Guinea and Australia.
- These populations are east of the Wallace/Huxley line that forms the boundary between placental mammals to the west, and marsupials to the east - a geographical barrier.
- Indigenous populations west of the Wallace/Huxley line do not have much Denisovan ancestry, ruling out interbreeding in central and east Asia.
- One possibility: interbreeding near the islands or in mainland Southeast Asia.
- Another possibility: southern China.

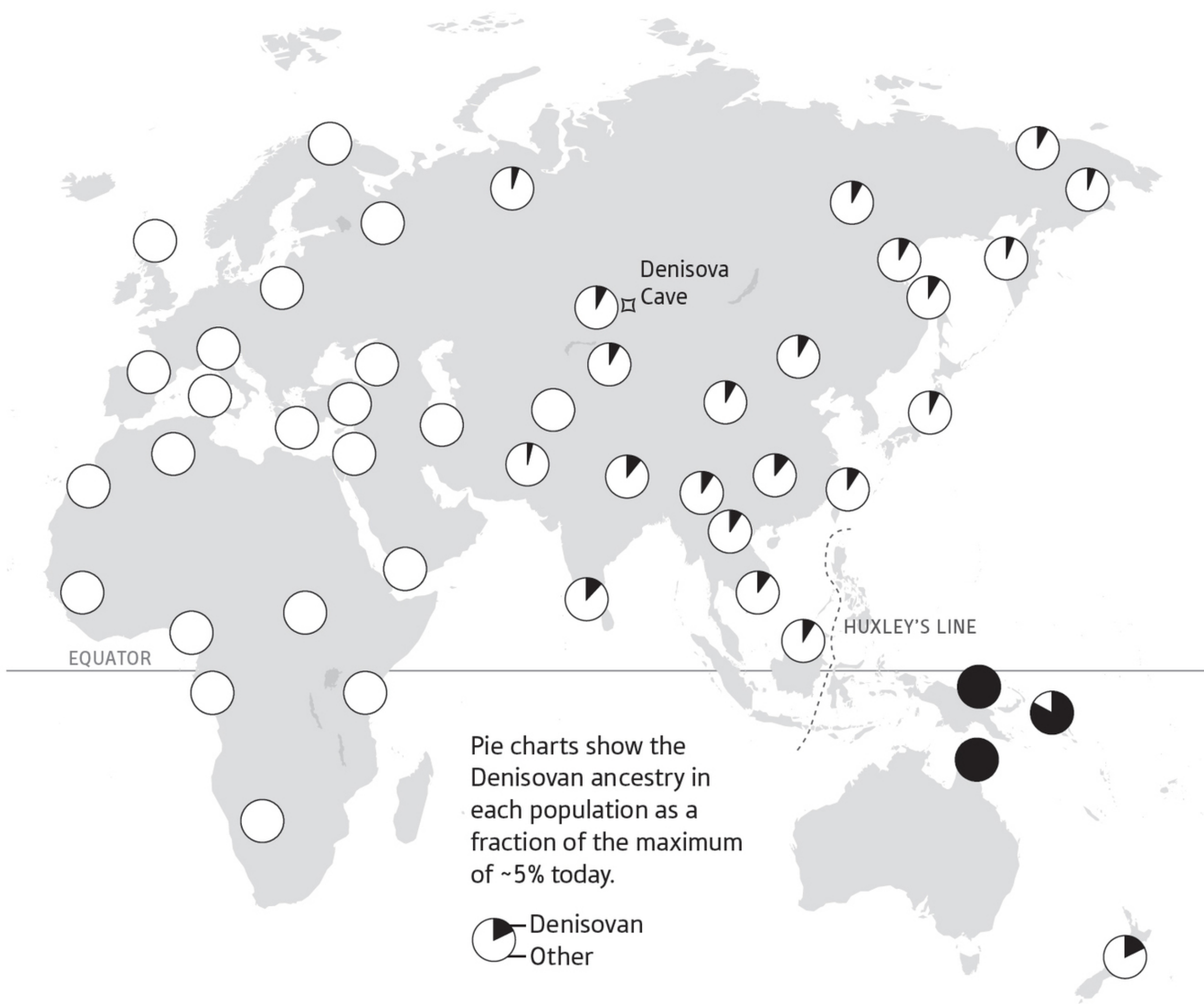
Denisovans and New Guineans

Location of the Interbreeding

Proportions of Neanderthal Ancestry in People Today



Proportions of Denisovan Ancestry in People Today



Huxley-Wallace Line

LGM - 20,000 YA

Wallace's Line delineates Australian and Southeast Asian fauna. The probable extent of land at the time of the [last glacial maximum](#), when the sea level was more than 110 m (360 ft) lower than today, is shown in grey. The deep water of the [Lombok Strait](#) between Bali and Lombok formed a water barrier even when lower sea levels linked the now-separated islands and landmasses on either side.



Australo-Denisovans

New Archaic Human Population

- Genome comparison of present-day New Guineans and Australians:
 - The number of variances between them and Siberian Denisovans indicated their ancestors separated from a common parent population 400,000 to 280,000 years ago.
 - This meant the ancestors of the Siberian Denisovans separated from the Denisovan lineage that contributed ancestry to New Guineans.
 - This separation occurred 2/3rds of the way back to the separation of Denisovans and Neanderthals.
- This separation resulted in the Australo-Denisovans.

Ancestor of Neanderthals and Denisovans

- Not *Homo Erectus*:
 - *Homo Erectus* migration out of Africa occurred 1.8 million years ago.
 - Split of Neanderthals and Denisovans should then be close to this age.
 - But genetic data give a split date of 770,000 to 550,000 years ago.
- *Homo Heidelbergensis* fits the bill. Stay tuned for more later.

Superarchaic Humans

Another New Archaic Human Population

- Sub-Saharan Africans are more closely related to Neanderthals than to Denisovans.
- Reflects an example of interbreeding of Denisovans with a deeply divergent, unknown archaic population.
- This unknown archaic population split off from the lineage leading to modern humans 1.4 to 0.9 MYA, and contributed 3 to 6 percent of Denisovan ancestry.
- Reich calls this unknown archaic population “superarchaic” humans, a “ghost” population.

Hothouse Eurasia

- Four major population separations involving modern and archaic lineages:
 - *Homo Erectus* out of Africa into Eurasia 1.8 MYA.
 - Superarchaic group splitting off from the lineage leading to modern humans 1.4 to 0.9 MYA.
 - Modern humans separated from Denisovans and Neanderthals 770,000 to 550,000 years ago.
 - Denisovans and Neanderthals split 470,000 to 380,000 years ago.
- Question: Did all these splits occur in Africa?

Hothouse Eurasia

- Three of the most deeply branching lineages - Neanderthals, Denisovans, and superarchaic humans - are represented only in human specimens excavated from Eurasia.
- Suggesting that ancestral populations of modern humans, Neanderthals and Denisovans lived in Eurasia, descending from *Homo Erectus*.
- The superarchaic population, and the ancestral population of modern humans, Neanderthals and Denisovans could have arisen in Eurasia.
- There was a later migration from Eurasia back to Africa to establish shared ancestry with modern humans there.

Hothouse Eurasia

Homo Antecessor

- Human bones found in a cave in Spain and dated to 1,000,000 YA.
- Had traits indicating they were ancestral to modern humans and Neanderthals.
- Points to possibility that there was continuous Eurasian habitation from 1.4 MYA until the most recent common ancestor of human and Neanderthals after 800,000 YA.
- At which point one lineage migrated back to Africa to become the lineage that evolved into modern humans.

Hothouse Eurasia

Homo Heidelbergensis

- Sequenced mtDNA from 400,000 year old *Homo Heidelbergensis*, found in a cave in Spain.
- Had Neanderthal-like traits, and were on the lineage that led to Neanderthals.
- Sequenced whole genome DNA, confirmed they were on the lineage leading to Neanderthals.
- But they were also closer to Neanderthals than to Denisovans.
- Direct evidence that by 400,000 YA, the separation of Neanderthals and Denisovans had begun.

Hothouse Eurasia

- “The patterns suggest that Denisovans and Neanderthals both had ancestry from the same superarchaic population, with just a larger proportion present in the Denisovans.”

Next Up

- Read Chapter 4: Humanity's Ghosts
- Read Chapter 5: The Making of Modern Europe