

Genetics, Language, and the Prehistory of the Americas

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1 / 31

Outline

- ▶ Three waves of migration or one?
- ▶ Paleoamerican hypothesis
- ▶ Population growth in South America

2 / 31

Joseph Greenberg Hypothesis

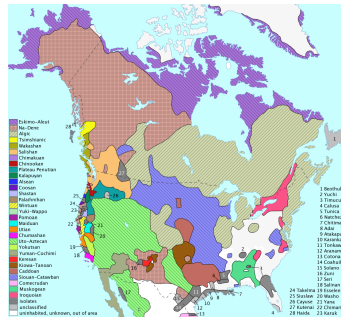


Greenberg advocated comparing many languages at a time, using a small list of slowly-changing words, to detect deep relationships.

Divided Amerindian languages into 3 major groups—Amerind, Na-Dene (including Athabascan), and Eskimo-Aleut—which in his view descend from 3 waves of migration into the Americas.

3 / 31

Dispute



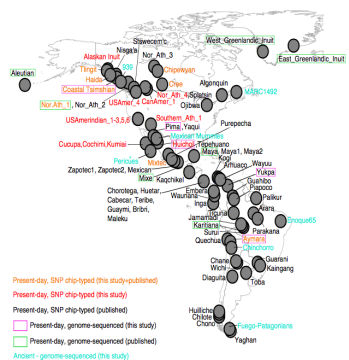
Most linguists don't accept Greenberg's method.

In their view, linguistic data are not informative that far back in the past.

Instead of 3 major groups, they recognize 150–180 independent language families.

4 / 31

Raghavan et al (2015) Study



Sequenced 31 modern Amerindian genomes and 23 ancient genomes. Also used previously-published genomes.

SNP chip genotypes from 79 individuals from 28 populations.

5 / 31

Early North Am. similar to modern South Am.

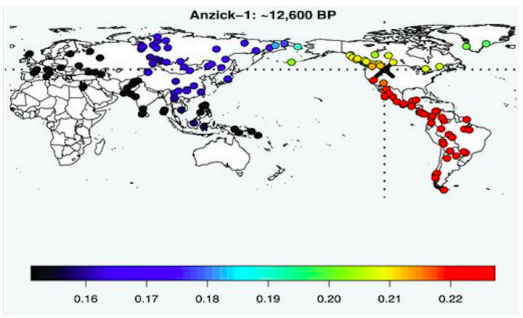
Next few slides compare DNA of ancient fossils with that of modern Amerindians.

General pattern: early fossils are genetically similar to modern Amerindians farther south.

Later fossils are similar to modern Amerindians of their own region.

6 / 31

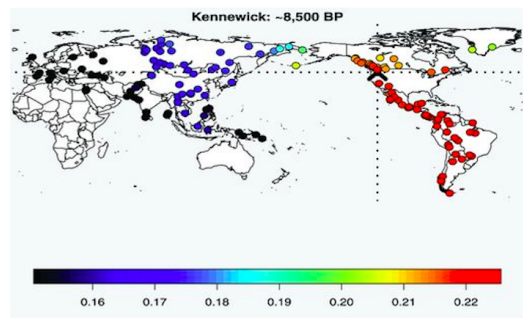
Pleistocene Anzick-1 fossil most similar to S Americans



Anzick fossil, of Clovis culture, was found in Montana.

DNA most similar to S American populations.

Early Holocene Kennewick fossil

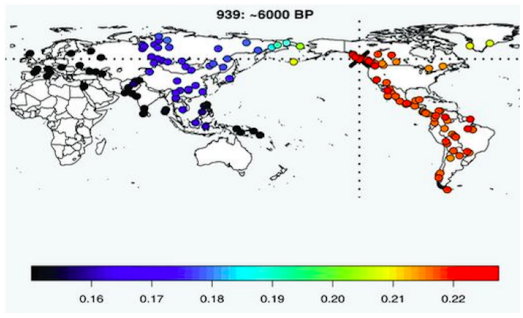


~8.5 ky old, from Washington state

DNA similar to Amerindians throughout US and S America.

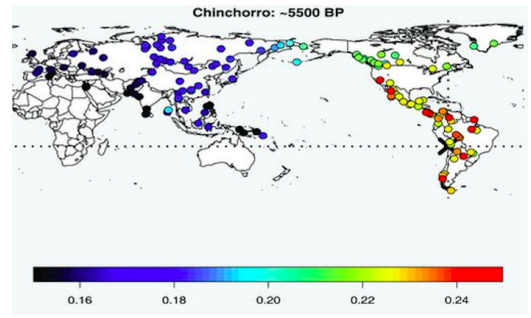
Not more similar to Amerindians of its own region, the Pacific Northwest.

A 6000 year old fossil



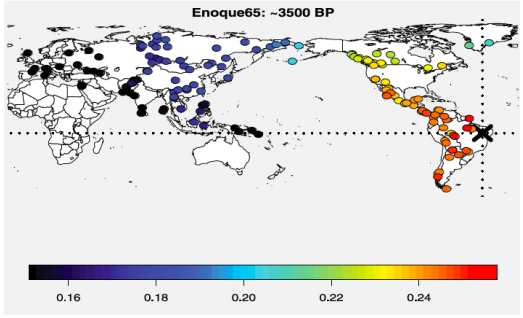
DNA still similar to Amerindians throughout US and S America.

A 5500 year old S American fossil



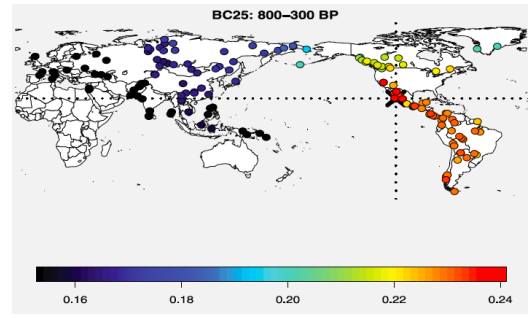
More similar to Amerindians of S America.

A 3500 year old S American fossil



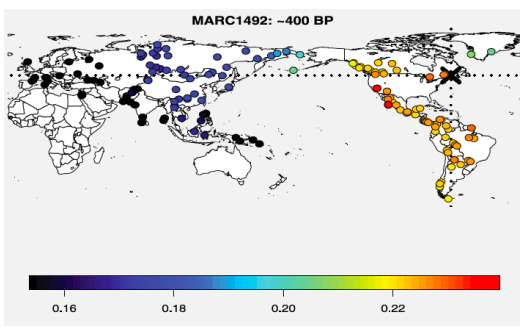
Most similar to Amerindians of its own region of S America.

A ~500 year old Mexican fossil



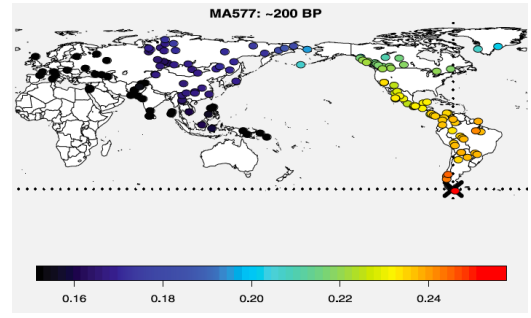
Most similar to Amerindians of Mexico.

A ~400 year old fossil from US Northeast



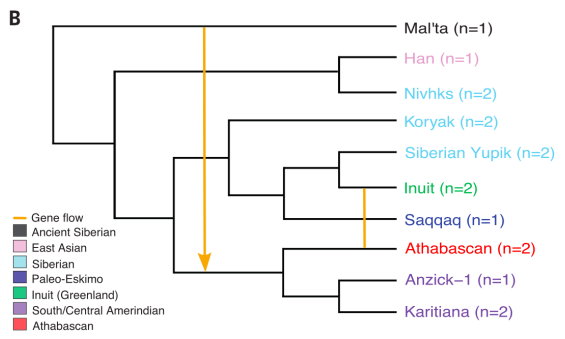
Most similar to Amerindians of US SW and Mexico.
An exception to the general rule.

A ~200 year old fossil from Tierra del Fuego



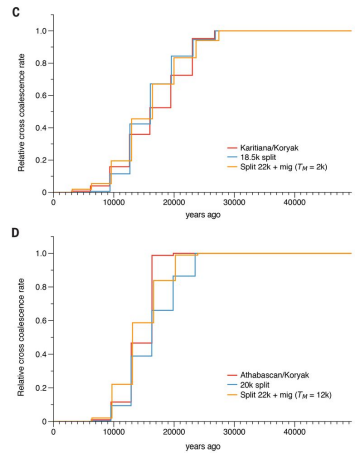
Most similar to Amerindians of Tierra del Fuego

Population Relationships



Consistent with Greenberg hypothesis; Anzick & Karitiana (Amerind) are related to Athabascan (Na Dene) and (less closely) to Inuit and Saqqaq (Eskimo-Aleut).

Dating the Asian-Amerindian Split

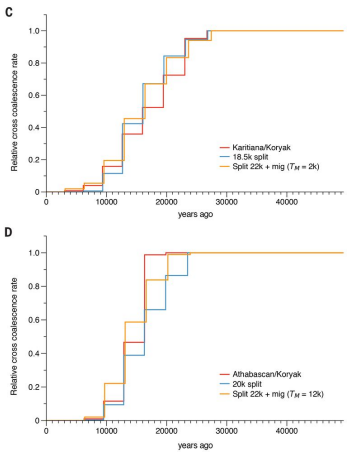


Comparing two Amerindian populations with the Koryak of eastern Siberia.

Upper panel: Karitiana are a S American population that speaks an Amerind language (in Greenberg's classification).

Lower panel: Athabascan is part of Greenberg's Na-Dene language family.

Split date contradicts Greenberg



Vertical axis estimates cumulative frequency of coalescent events.

Red: estimated from genetic data

Blue: best-fitting model without migration

Red: best-fitting model with migration

Amerinds and Athabascans both separated from Asians about 20 kya. (Upper bound: 23 kya)

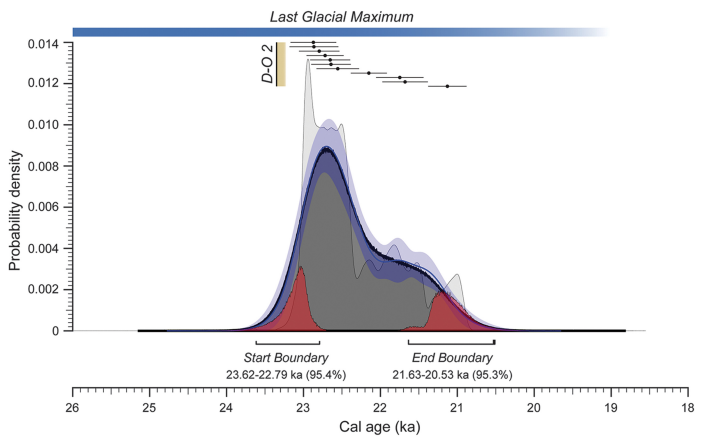
Footprints from White Sands, NM



Teenagers and children, walking in the mud of an ancient lake.

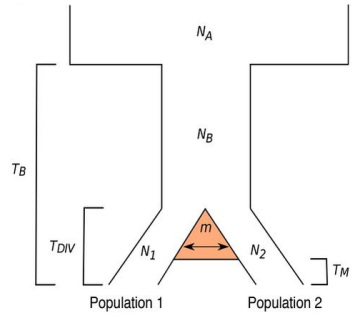
Southeast corner of New Mexico.

Footprints are 20–23 ky old



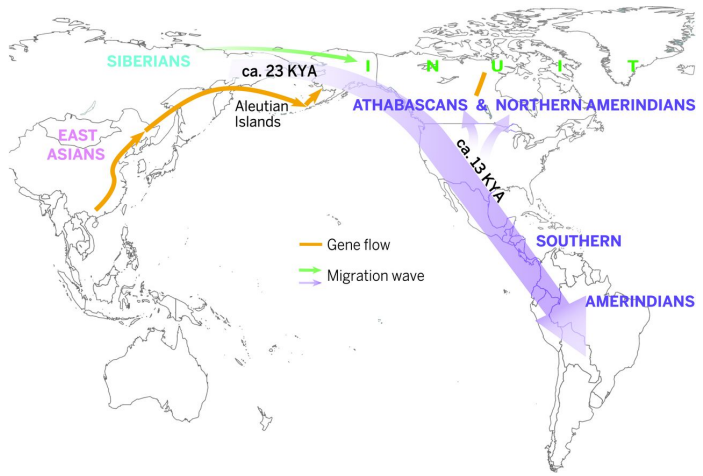
During last glacial maximum; oldest site in the Americas. Supports genetic chronology of Raghavan et al (2015).

Separation wasn't sudden



T_B generations ago, the ancestral population changes size.
 T_{DIV} generations ago, it splits in two, but the subdivisions continue exchanging migrants.
 T_M generations ago, migration stops.

Colonization of the Americas



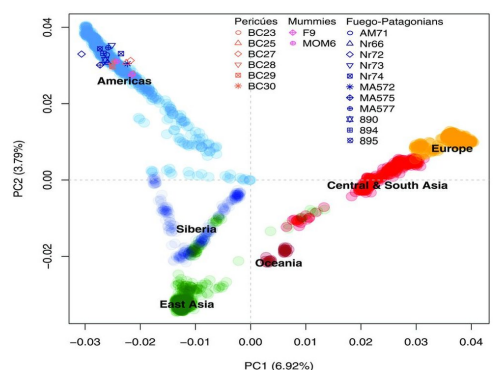
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- Three waves of migration or one?
- ▶ Paleoamerican hypothesis
- ▶ Population growth in South America

Paleoamerican Model (Gonzalez et al 2008)

- ▶ Earliest American fossils differ in skull shape from later ones.
- ▶ More like modern Australians and Melanesians.
- ▶ These earliest Americans were mostly replaced by Amerindians who arrived later.
- ▶ Evidence is from early skeletons and a few historical relict populations, now extinct: the Pericúes and the Fuego-Patagonians.
- ▶ Hypothesis predicts these populations should have DNA like Australians and Melanesians, not Amerindians.

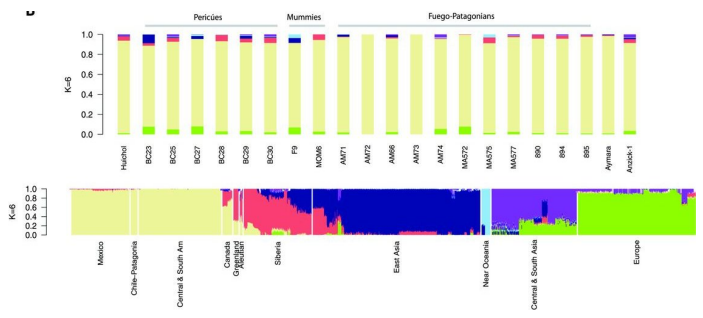
Testing the Paleoamerican model



Principal components plot.
 Modern Amerindians are the blurry blue points in the upper left.
 Ancient Amerindians, including Pericúes and Fuego-Patagonians,

plot with modern Amerindians. No ancient Amerindians with Oceanians.

Testing the Paleoamerican model

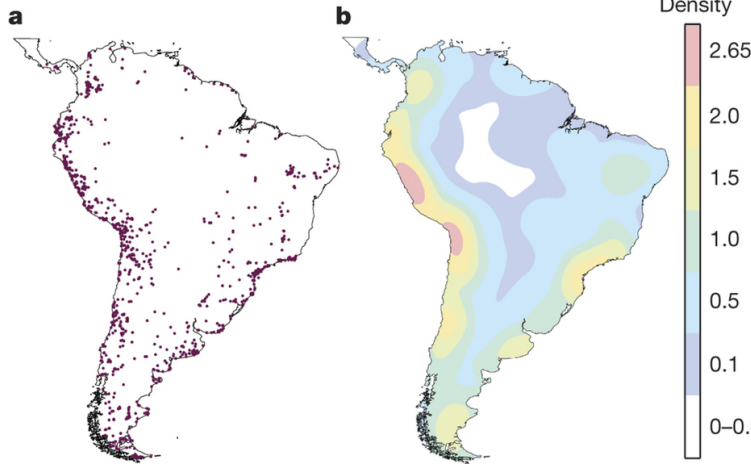


Pericúes & Fuego-Patagonians have DNA like Amerindians, not like Oceanians.
 Refutes Paleoamerican hypothesis. (Raghavan et al 2015)

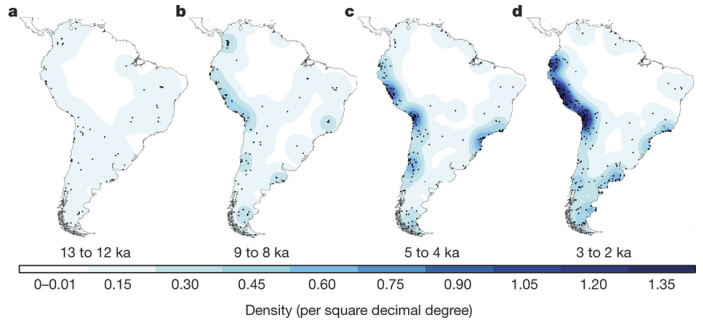
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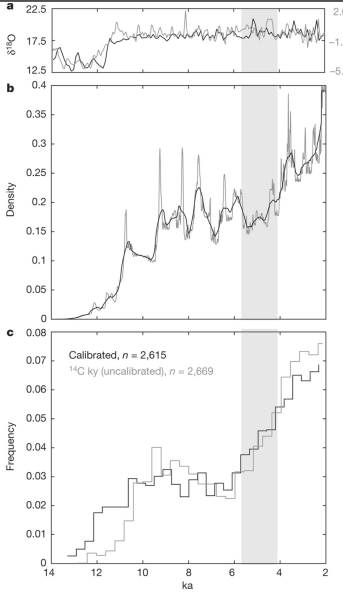
South American archaeological sites



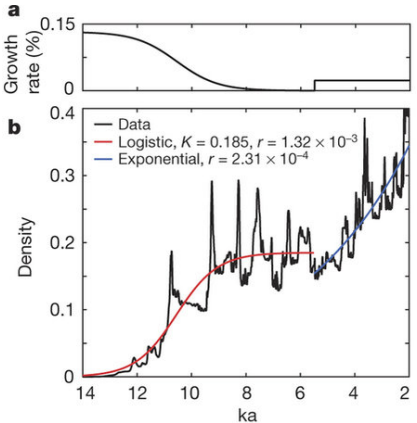
Density of radiocarbon dates (Goldberg et al 2016)



Radiocarbon dates serve as proxy for population size.
 No information in the Amazon basin.
 Coastal population growth accelerates after 5 kya.



Temperature and population
 a, temperature; b, radiocarbon density; c, frequency of sites.
 Early growth; crash at 11 kya; plateau during 10–6 kya; then more growth.
 Megafauna went extinct 11 kya; sedentary agriculture began 5.5–3.5 kya.
 1000-year oscillations during plateau. Don't know why.
 (Goldberg et al 2016)



Fitting a model
 Top: growth rate; Bottom: population size.
 Before 6 kya, growth rate declines as population increases.
 After 6 kya, growth rate stable as population increases.
 (Goldberg et al 2016)

Summary

- ▶ All Amerindians, including ancient ones, separated from Asians about 22 kya.
- ▶ Separation wasn't sudden.
- ▶ Na-Dene (incl Athabascans) separated from Amerinds about 13 kya.
- ▶ Regional genetic differences developed gradually, over thousands of years.
- ▶ Paleoamerican hypothesis is false: earliest Americans not related to Oceanians.
- ▶ Population history of South American: initial growth leading to a plateau, then renewed growth after agriculture.