



Atlas of Phanerozoic Climatic Zones

CR Scotese, PALEOMAP Project
AJ Boucot & Chen Xu

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The Atlas of Phanerozoic Climatic Zones plots the location of five principal climatic zones on 28 paleogeographic maps ranging in age from early Cambrian to Miocene. The five principal climatic zones are: 1) Tropical Everwet (green shading), 2) Subtropical Arid (yellow shading), 3) Warm Temperate (yellow-green shading), 4) Cool Temperate (brown shading), and 5) Cold Polar (white shading). These five climatic zones correspond to the major Koeppen climatic zones A through E.

On several maps, an additional climatic zone, the "Boreal Tropical" zone is shown. In the Boreal Tropical climatic belt (olive green shading), tropical everwet conditions are present at anomalously high temperate latitudes (45° - 60° N and S latitudes). The Boreal Tropical Zone does not occur in today's world. It occurs only during times when the global mean annual temperature is in excess of 18°C (see Maps 9, 11, 13, 19, 23, 39, 43, and 45). These "Hot House" worlds are also characterized by the absence of polar ice caps.

In addition to plotting the paleoclimatic zones, the maps also show the distribution of rock types that form under specific climatic conditions. These lithologic indicators of climate, include: coals, bauxites, evaporites (salt & gypsum), calcretes, kaolinities, tillites, glendonites and dropstones (Figure 1). A complete description of each of these lithologic indicators of climate can be found in the compendium by Boucot et al., 2013. Reef localities (blue asterisks) have also been plotted on the maps (Kiessling et al., 2002).

Unlike the paleoclimatic zones in the other atlases (Scotese, 2014, a,b,c,d,e) which were based on the FOAM (Fast Ocean and Atmosphere) paleoclimatic simulations, the climatic zones plotted on these maps were drawn to conform with the distribution of these lithologic indicators of climate. The Tropical Everwet zone was mapped based on the distribution of coals and bauxites. The Subtropical Arid zone was mapped based on the distribution of evaporites and calcretes. The Warm Temperate Belt includes kaolinities, as well as coals. The Cool Temperate zone is based mostly on high latitude coals in association with tillites, glendonites, and dropstones. The Polar Cold zone is based entirely on the occurrence of tillites, glendonites, and dropstones. For a summary of the relationship between the lithologic indicators of climate and the climatic zones, see Figure 1.

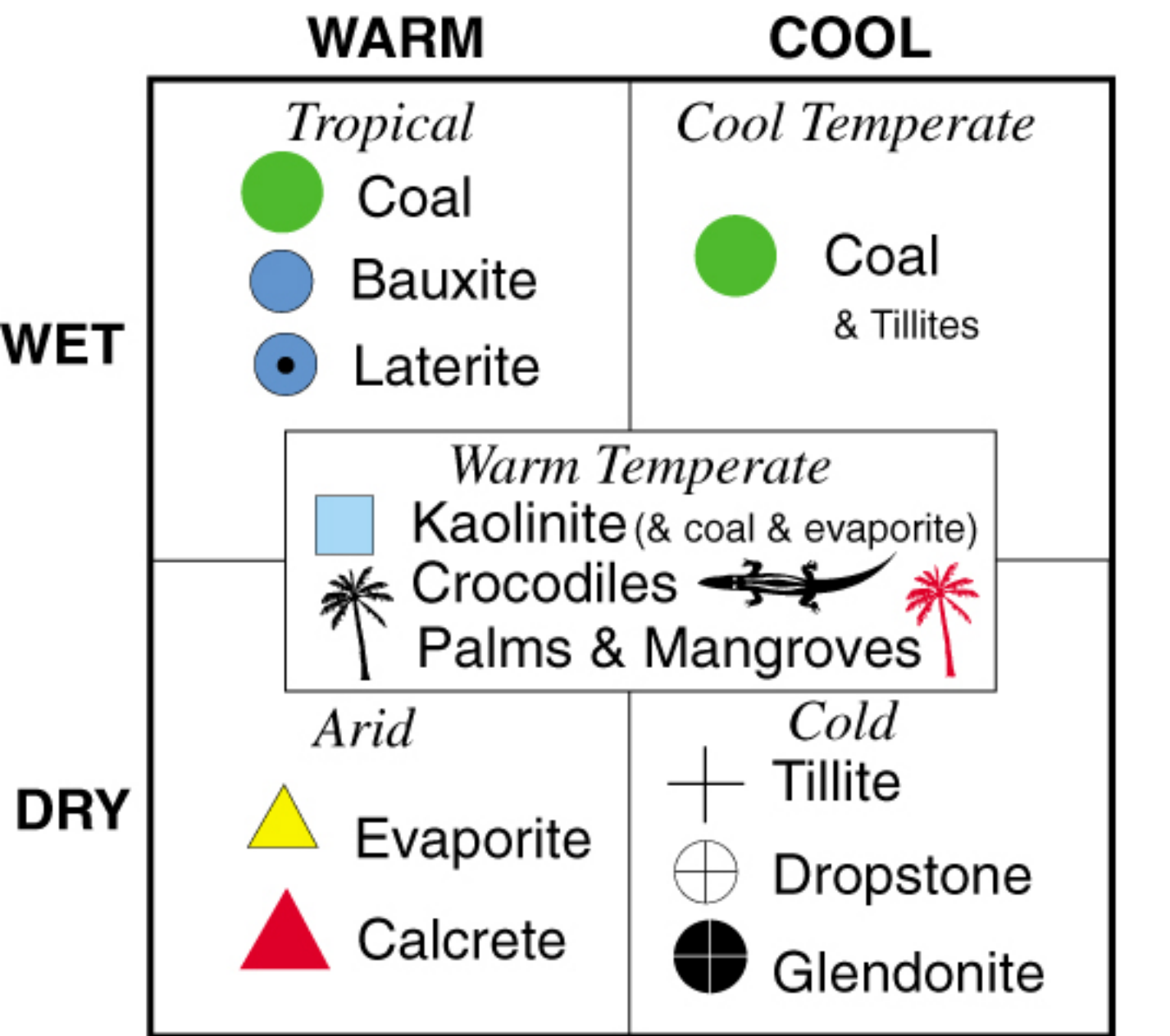
The reef localities were not used to draw the climatic zones. The distribution of reefal facies, therefore, is an important, independent test of the inferred climatic zones. As expected, the reefs predominantly occur in tropics and subtropics (15° - 35° , N&S). There are no reefs above 45° N&S latitude. Most of the reefs occur in the Subtropical Dry zone where it is both warm and sunny, and where there are fewer river deltas and other sources of clastics that might inhibit reef growth.

This work should be cited as
Scotese, C.R., Boucot, A.J, and Chen Xu, 2014. Atlas of Phanerozoic Climatic Zones (Mollweide Projection), Volumes 1-6, *PALEOMAP Project* PaleoAtlas for ArcGIS, PALEOMAP Project, Evanston, IL.

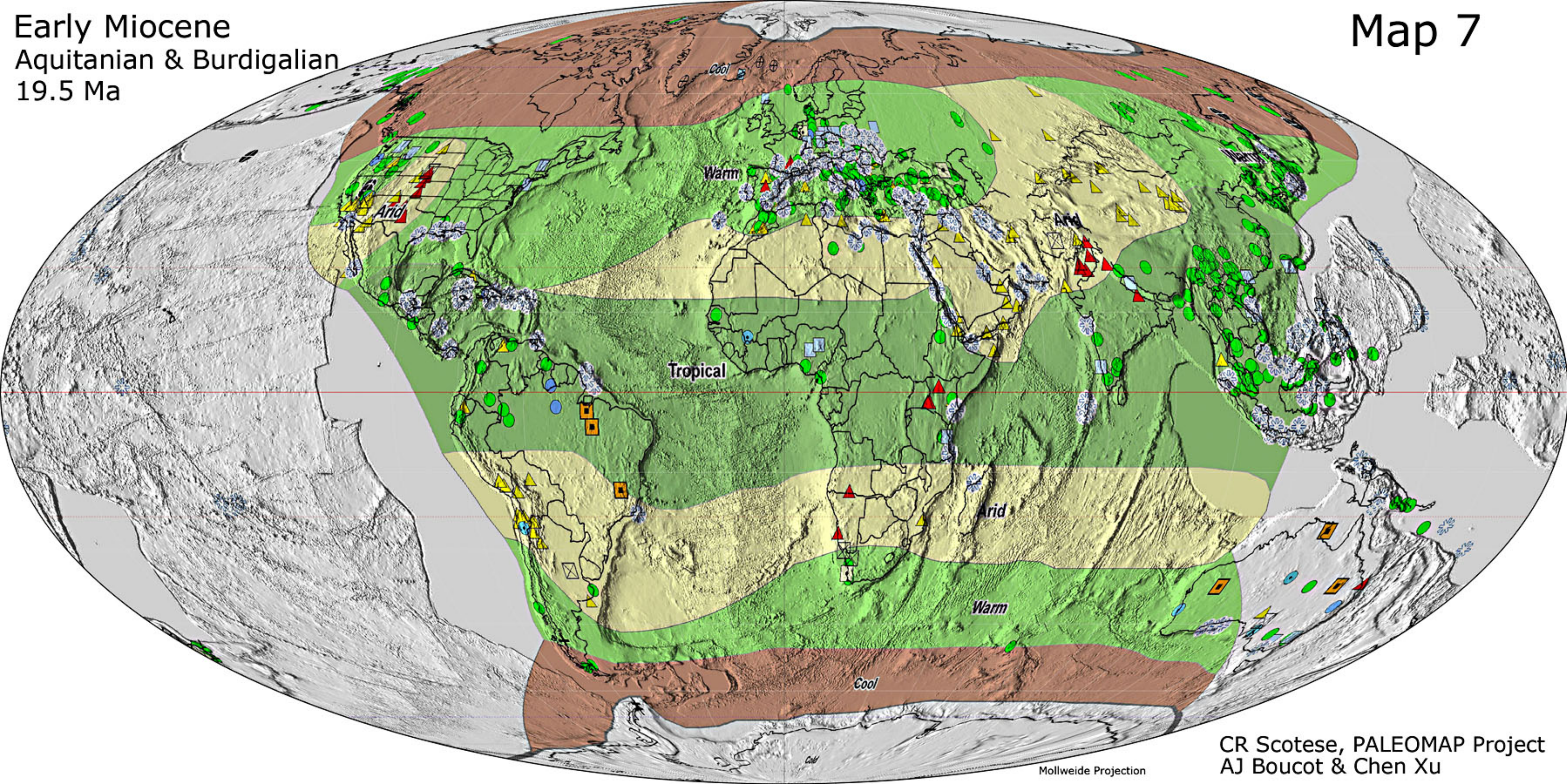
References Cited:

- Boucot, A.J., Chen Xu, and Scotese, C.R., 2013. Phanerozoic Paleoclimate: An Atlas of Lithologic Indicators of Climate, SEPM Concepts in Sedimentology and Paleontology, (Print-on-Demand Version), No. 11, 478 pp., ISBN 978-1-56576-289-3, October 2013, Society for Sedimentary Geology, Tulsa, OK.
- Kiessling, W., Flügel, E., and Golonka, J., (editors) 2002. Phanerozoic Reef Patterns, SEPM (Society for Sedimentary Geology), Special Publications, 775 pp.
- Scotese, C.R., 2014a, *The PALEOMAP Project PaleoAtlas for ArcGIS*, version 2, Volume 1, Cenozoic Plate Tectonic, Paleogeographic, and Paleoclimatic Reconstructions, Maps 1-15, PALEOMAP Project, Evanston, IL.
- Scotese, C.R., 2014b, *The PALEOMAP Project PaleoAtlas for ArcGIS*, version 2, Volume 2, Cretaceous Plate Tectonic, Paleogeographic, and Paleoclimatic Reconstructions, Maps 16-32, PALEOMAP Project, Evanston, IL.
- Scotese, C.R., 2014c, *The PALEOMAP Project PaleoAtlas for ArcGIS*, version 2, Volume 3, Triassic and Jurassic Plate Tectonic, Paleogeographic, and Paleoclimatic Reconstructions, Map 33-48, PALEOMAP Project, Evanston, IL.
- Scotese, C.R., 2014d, *The PALEOMAP Project PaleoAtlas for ArcGIS*, version 2, Volume 4, Late Paleozoic Plate Tectonic, Paleogeographic, and Paleoclimatic Reconstructions, Map 49-74, PALEOMAP Project, Evanston, IL.
- Scotese, C.R., 2014e, *The PALEOMAP Project PaleoAtlas for ArcGIS*, version 2, Volume 5, Early Paleozoic Plate Tectonic, Paleogeographic, and Paleoclimatic Reconstructions, Maps 75-88, PALEOMAP Project, Evanston, IL.
- Scotese, C.R., 2014f, *The PALEOMAP Project PaleoAtlas for ArcGIS*, version 2, Volume 6, Precambrian Plate Tectonic, Paleogeographic, and Paleoclimatic Reconstructions, Maps 89-103, PALEOMAP Project, Evanston, IL.

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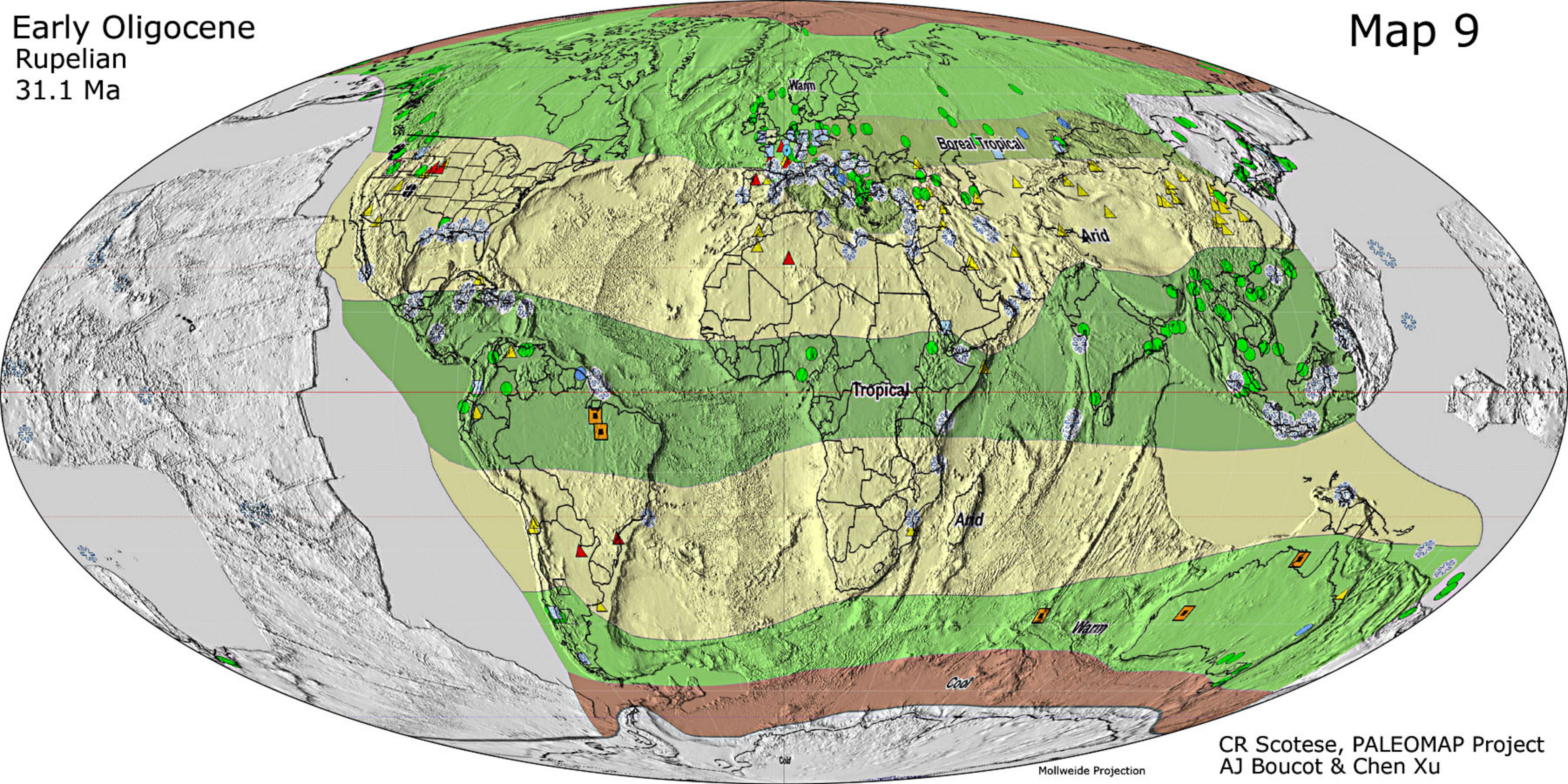


"Paratropical" = High Latitude Bauxites



Early Oligocene
Rupelian
31.1 Ma

Map 9

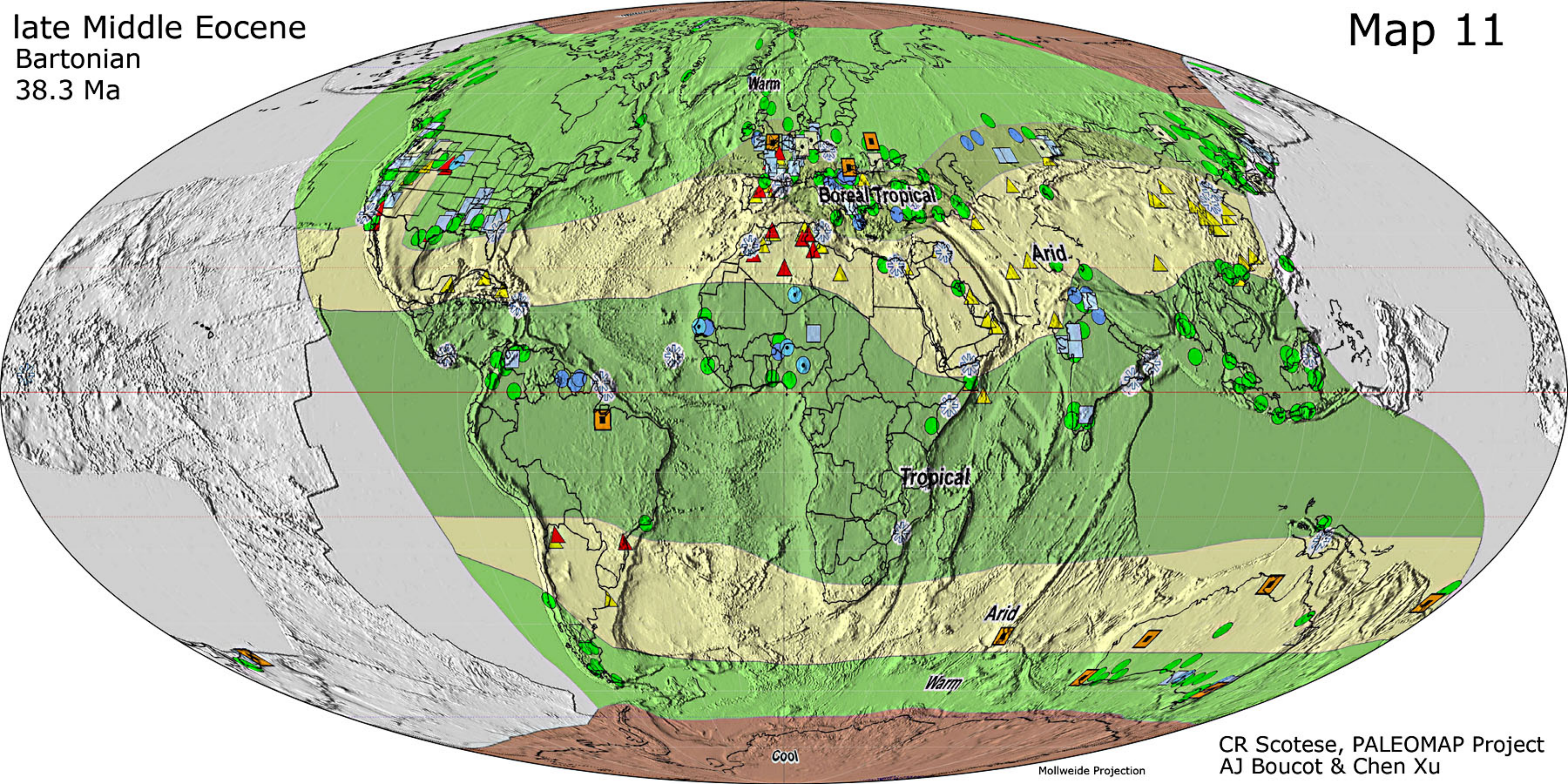


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Mollweide Projection

late Middle Eocene
Bartonian
38.3 Ma

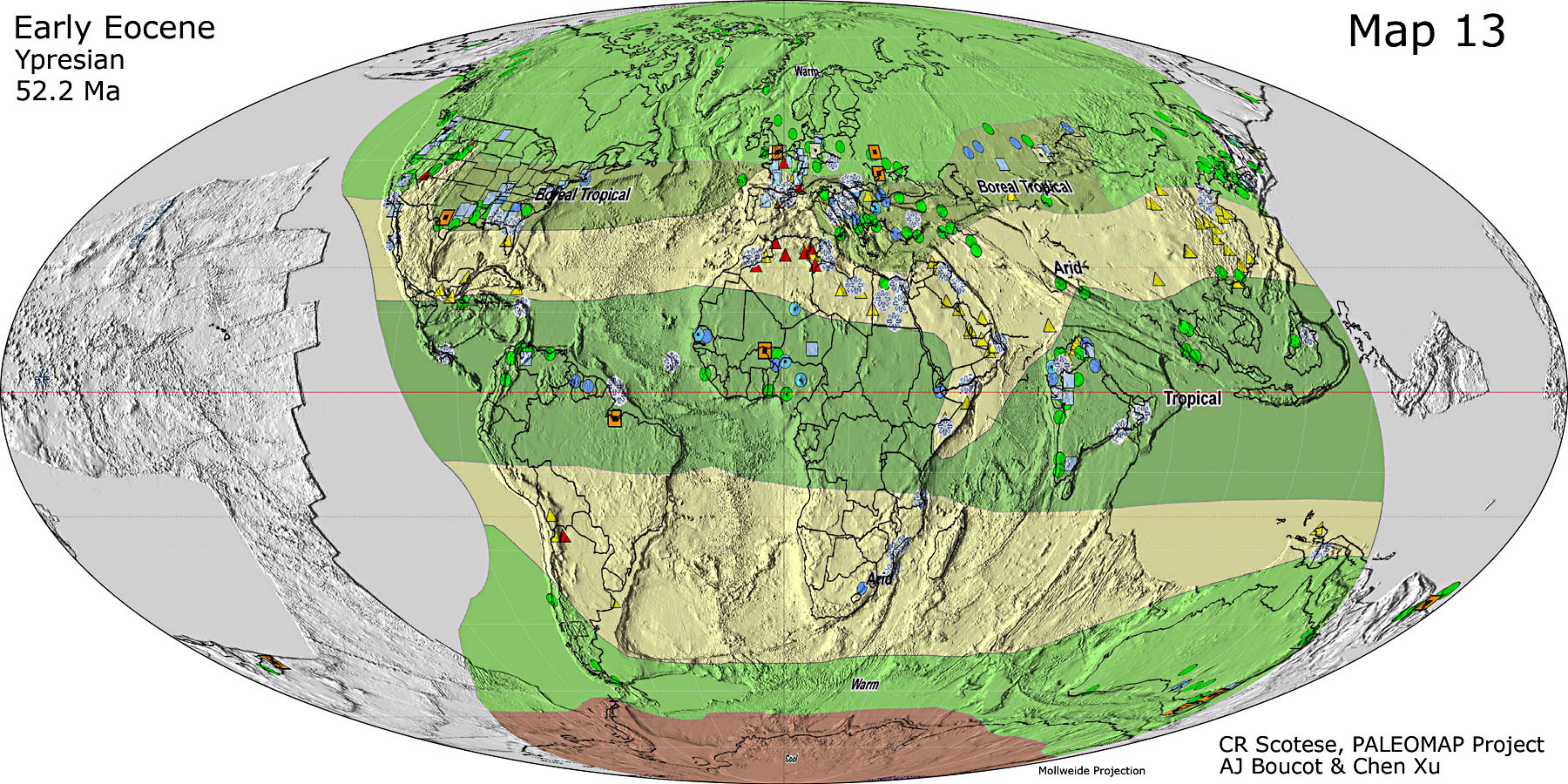
Map 11



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Early Eocene
Ypresian
52.2 Ma

Map 13



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Mollweide Projection

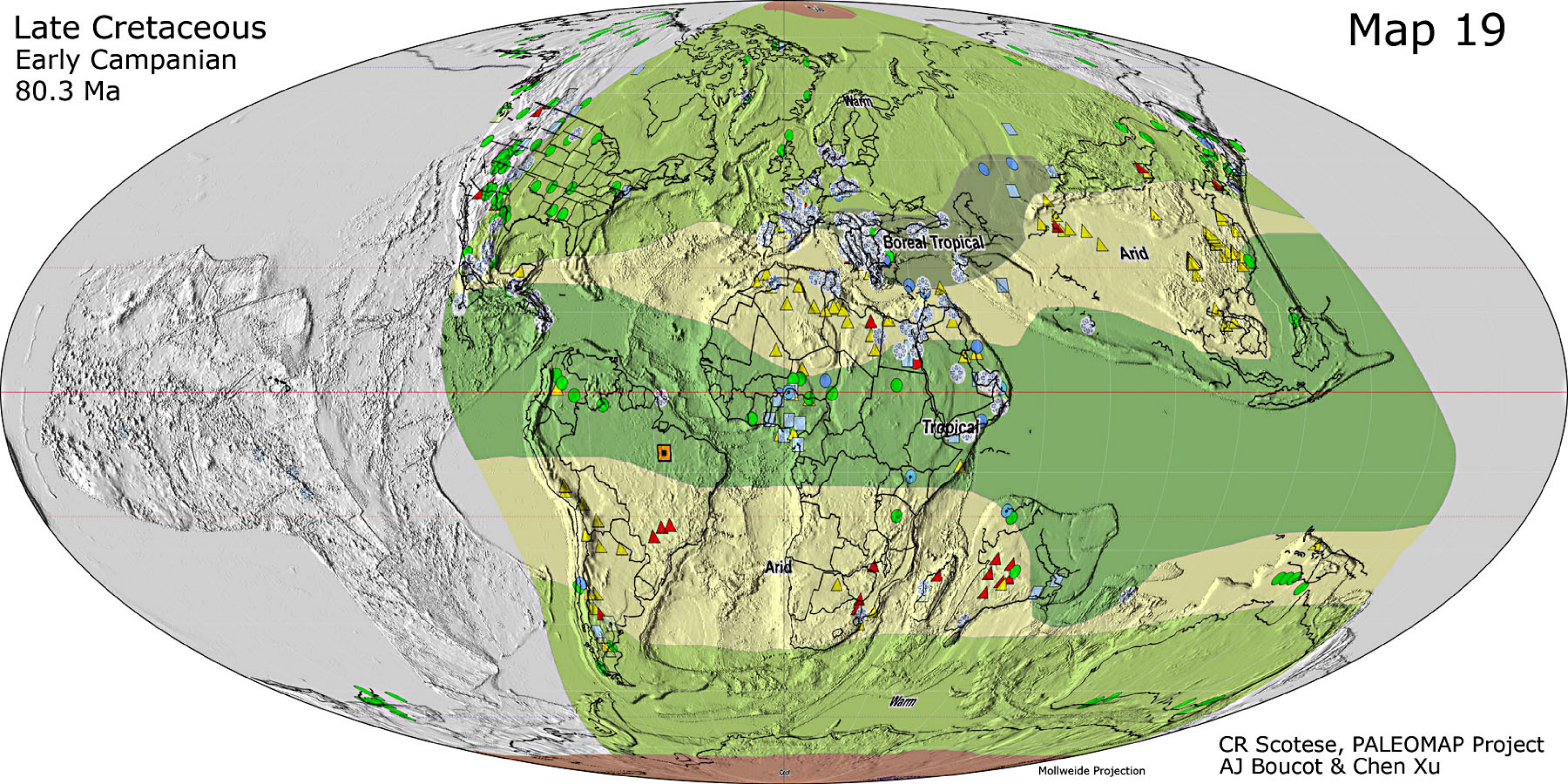
Paleocene
Danian & Thanetian
60.6 Ma

Map 15

Map in Preparation

Late Cretaceous
Early Campanian
80.3 Ma

Map 19

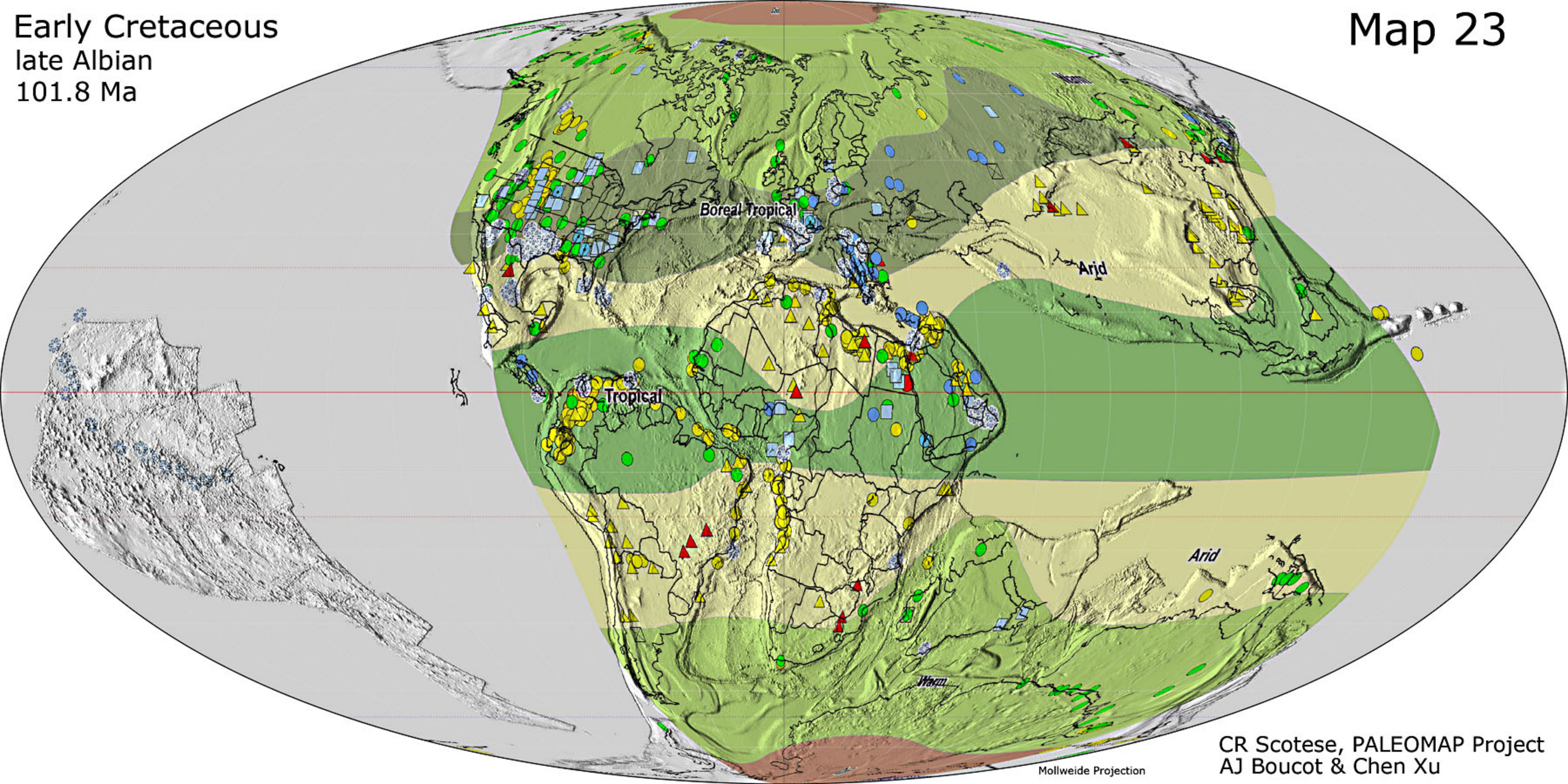


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Mollweide Projection

Early Cretaceous
late Albian
101.8 Ma

Map 23



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Mollweide Projection

Early Cretaceous
Berriasian
143 Ma

Map 31

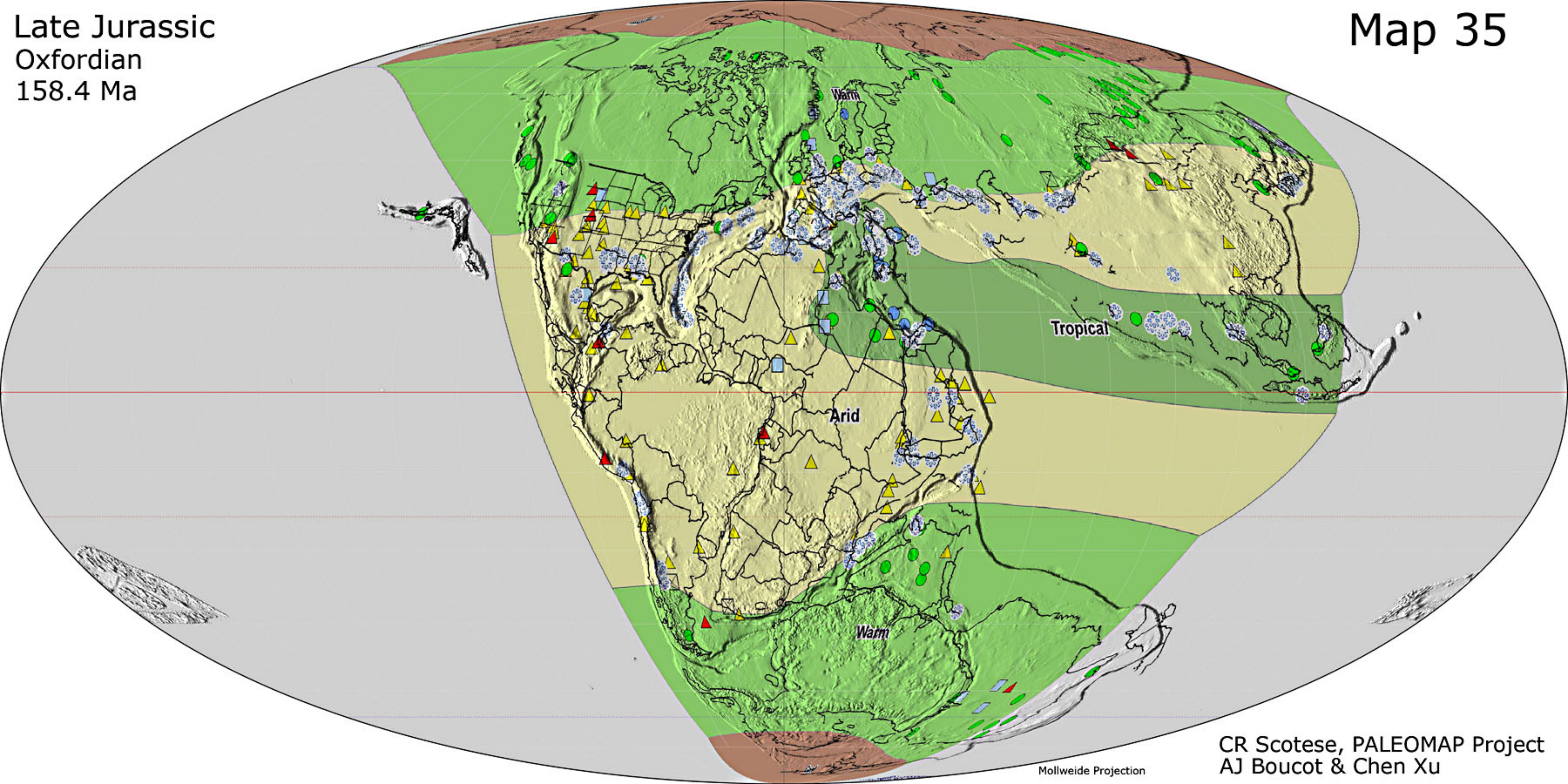
Under Revision

Mollweide Projection

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Late Jurassic
Oxfordian
158.4 Ma

Map 35

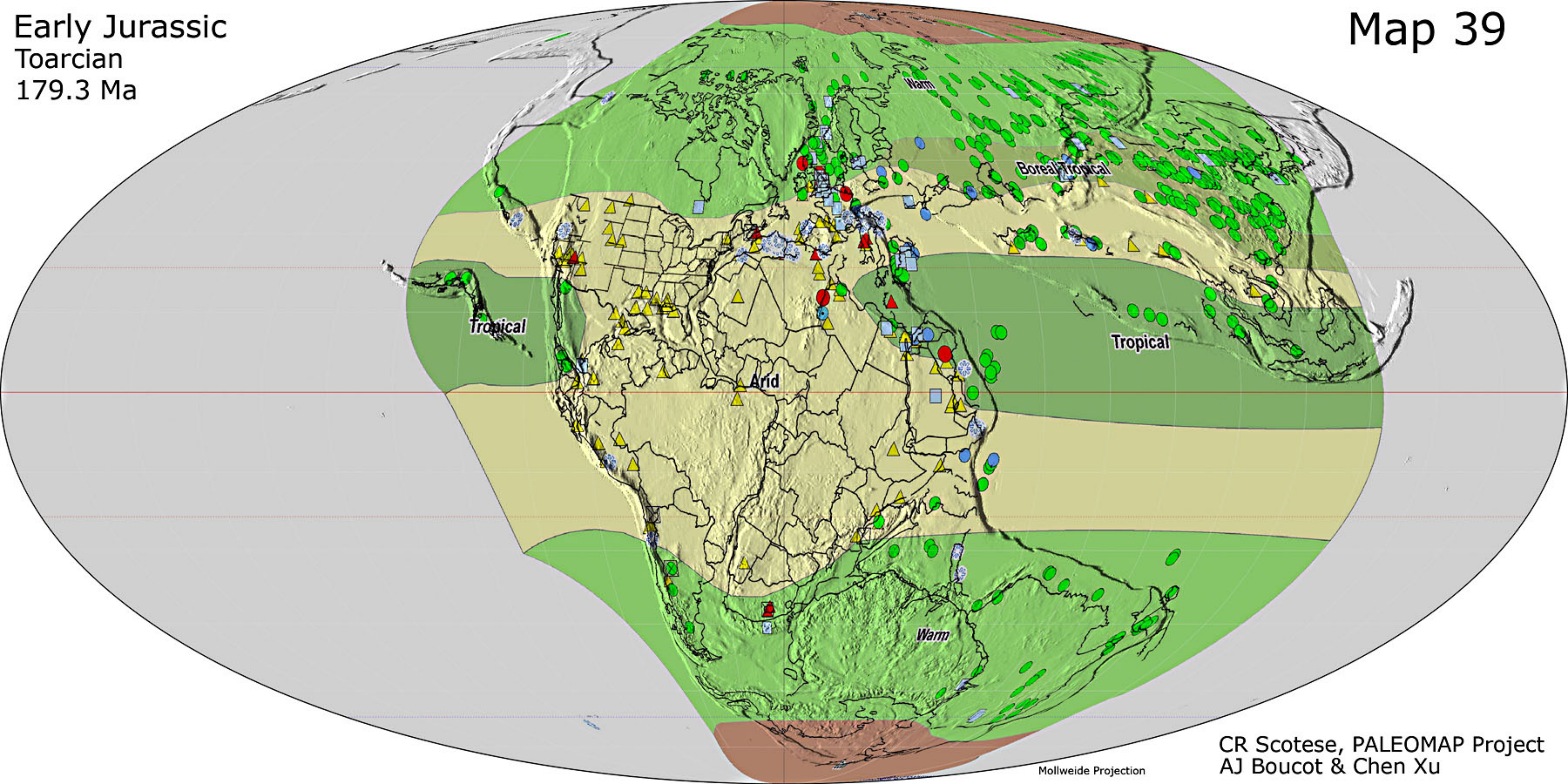


Mollweide Projection

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Early Jurassic
Toarcian
179.3 Ma

Map 39

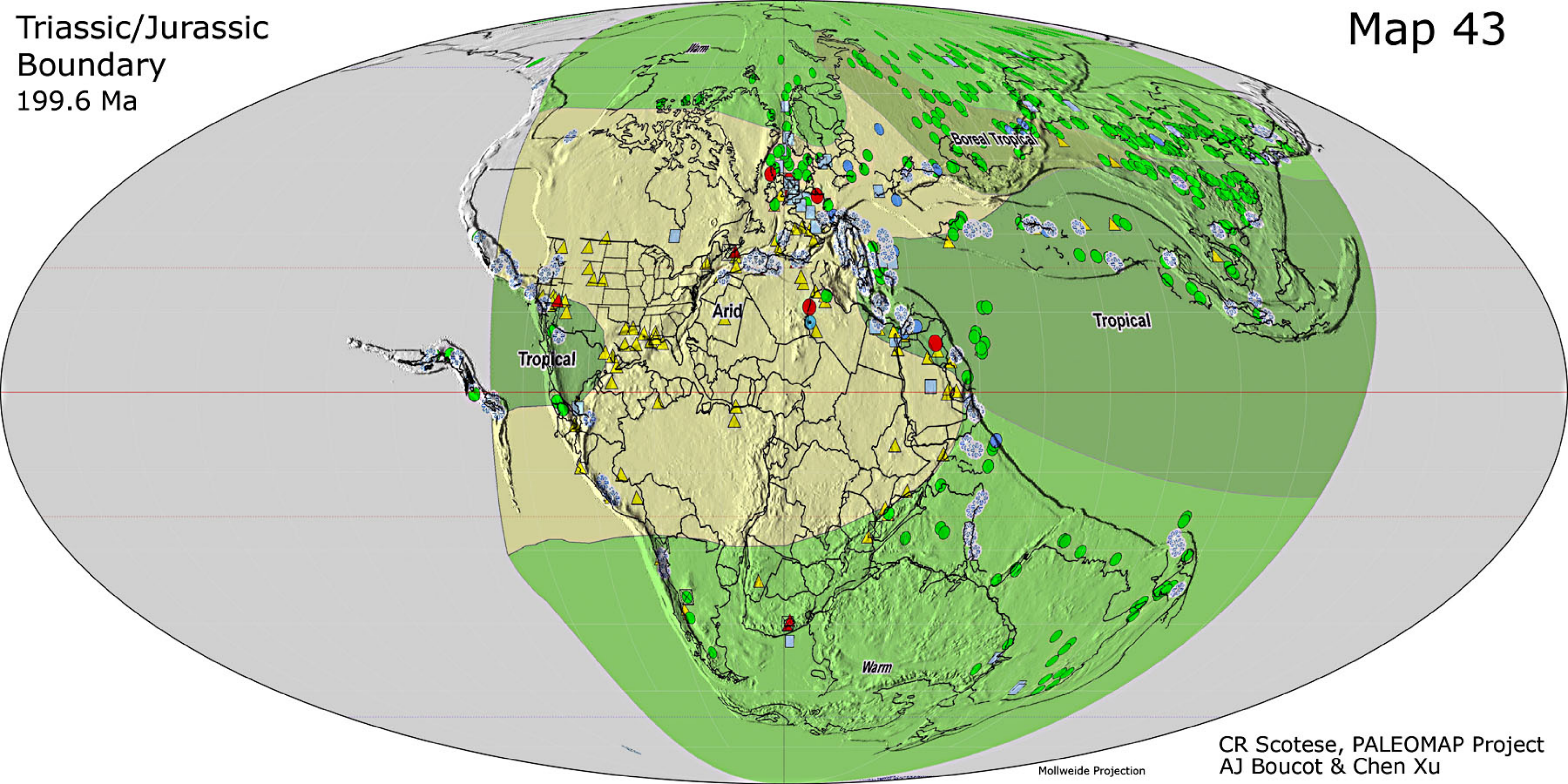


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Mollweide Projection

Triassic/Jurassic
Boundary
199.6 Ma

Map 43

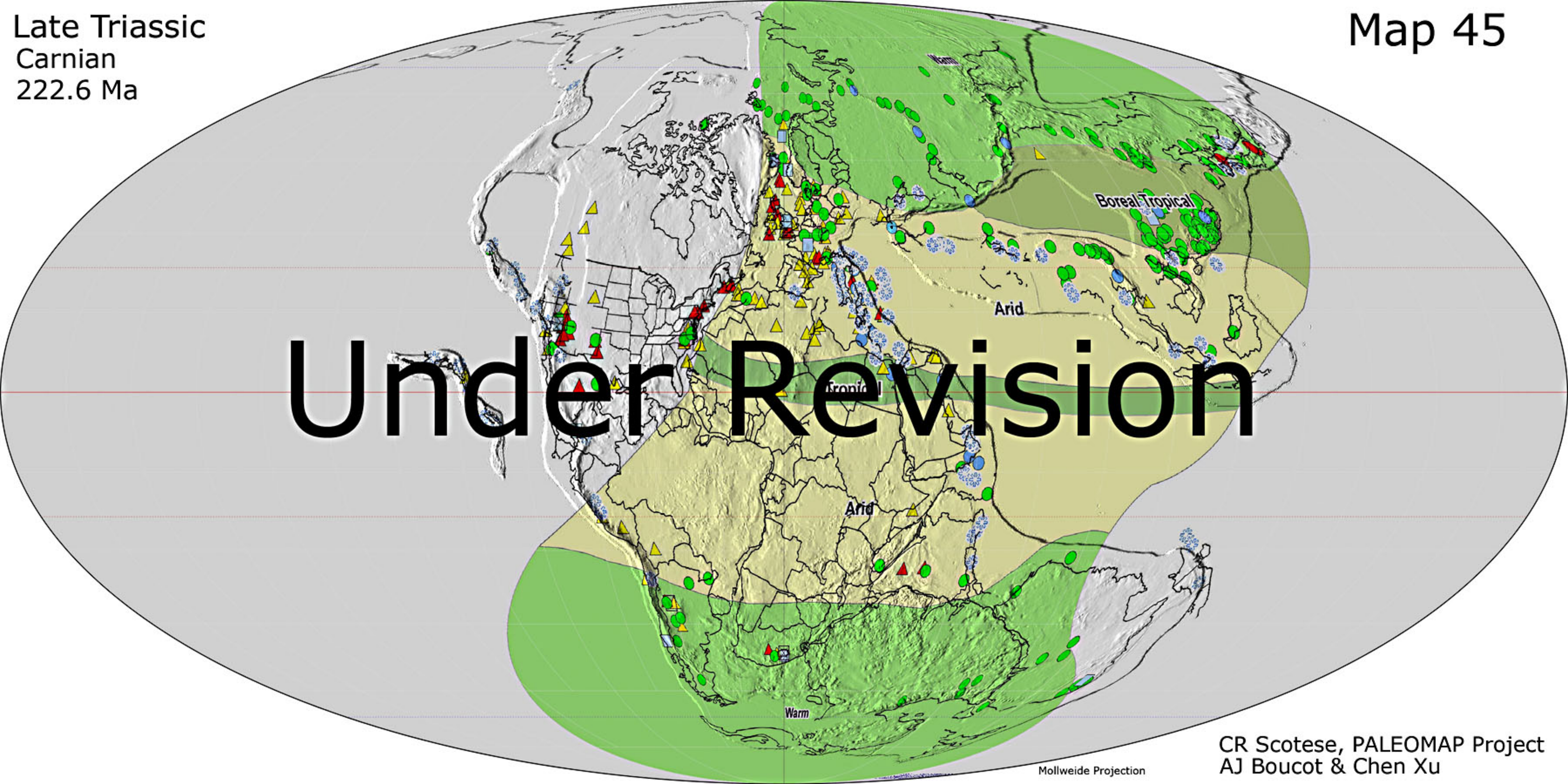


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Late Triassic
Carnian
222.6 Ma

Map 45

Under Revision

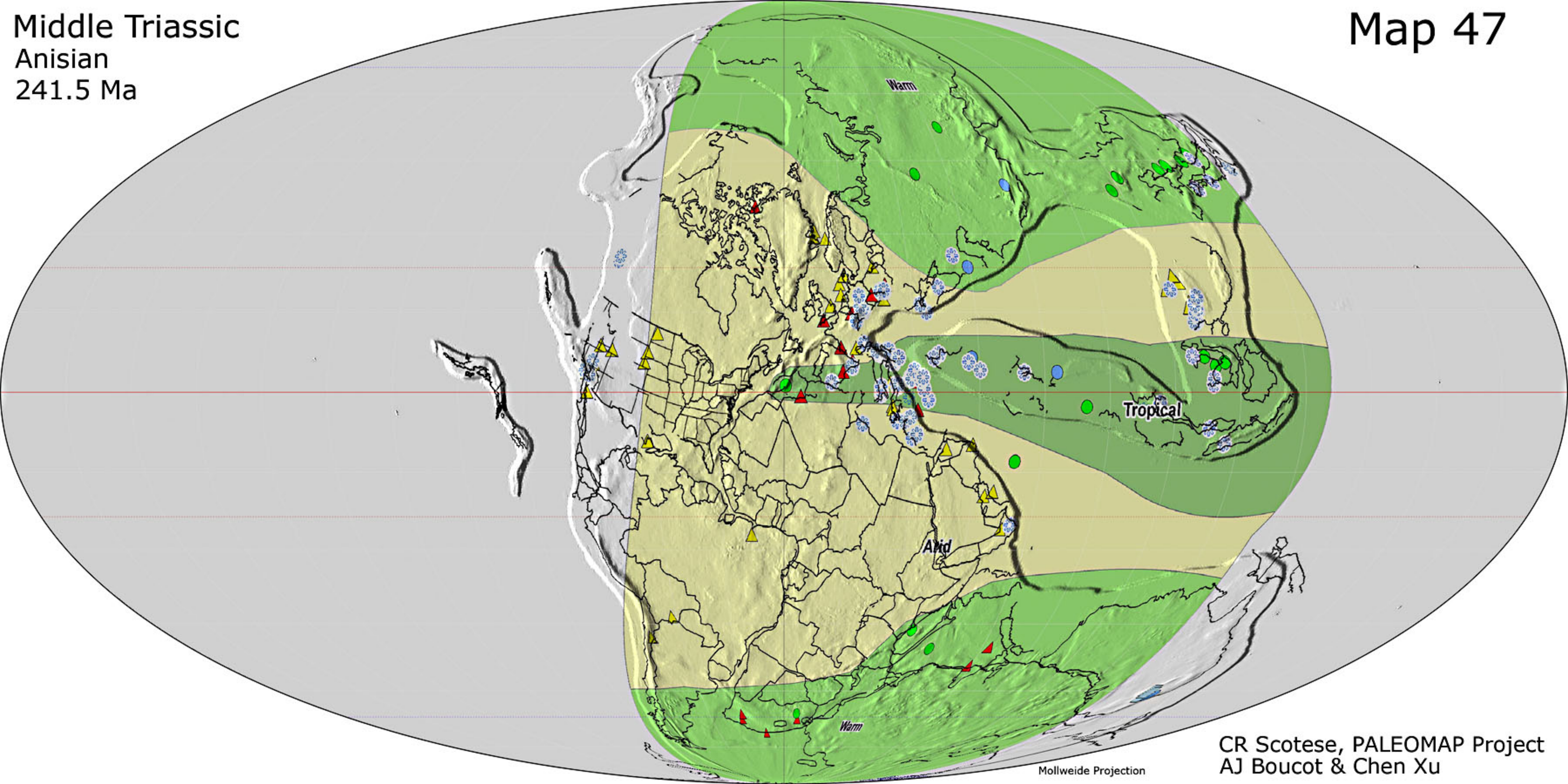


Mollweide Projection

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Middle Triassic
Anisian
241.5 Ma

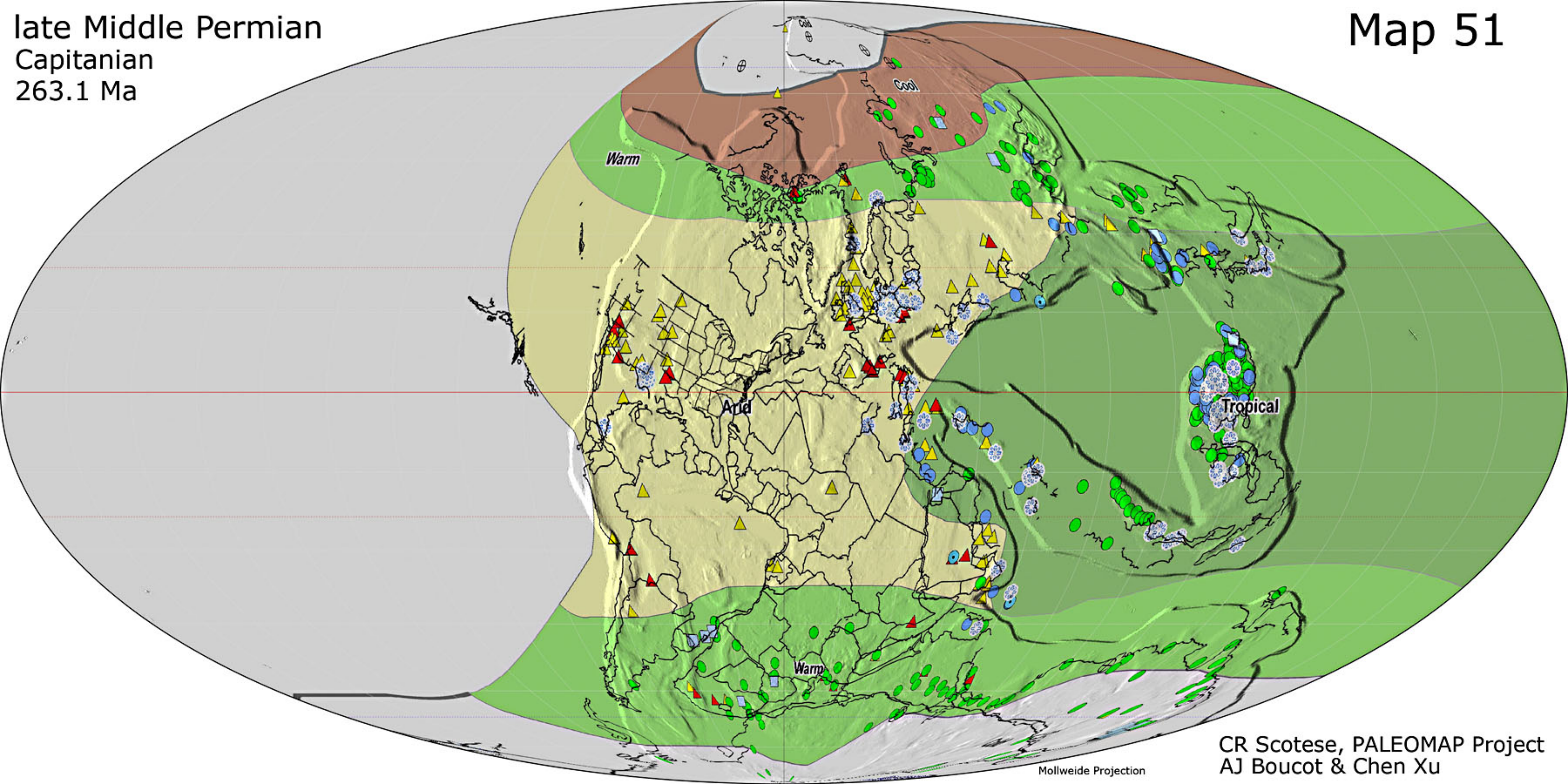
Map 47



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late Middle Permian
Capitanian
263.1 Ma

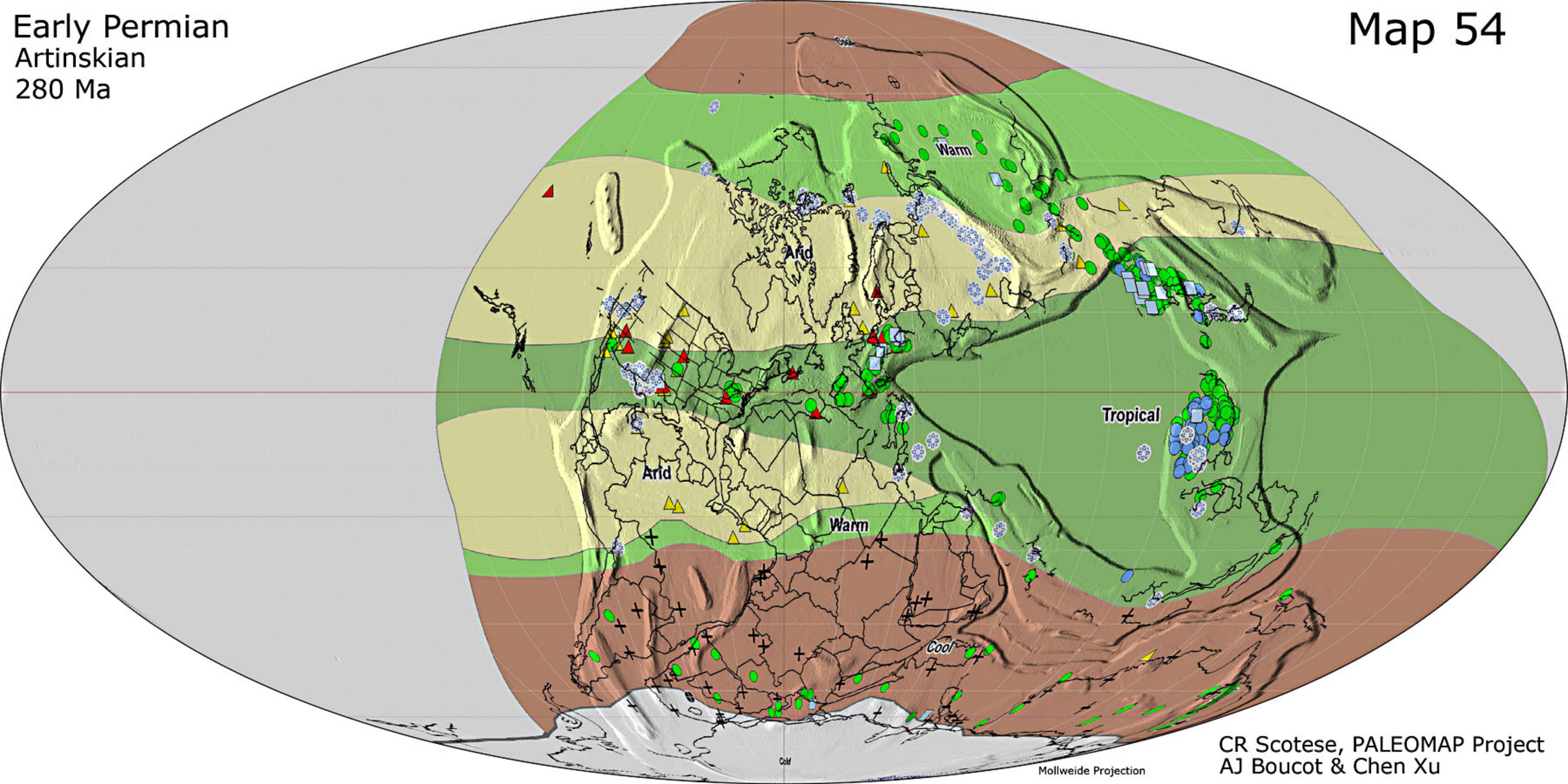
Map 51



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Early Permian
Artinskian
280 Ma

Map 54



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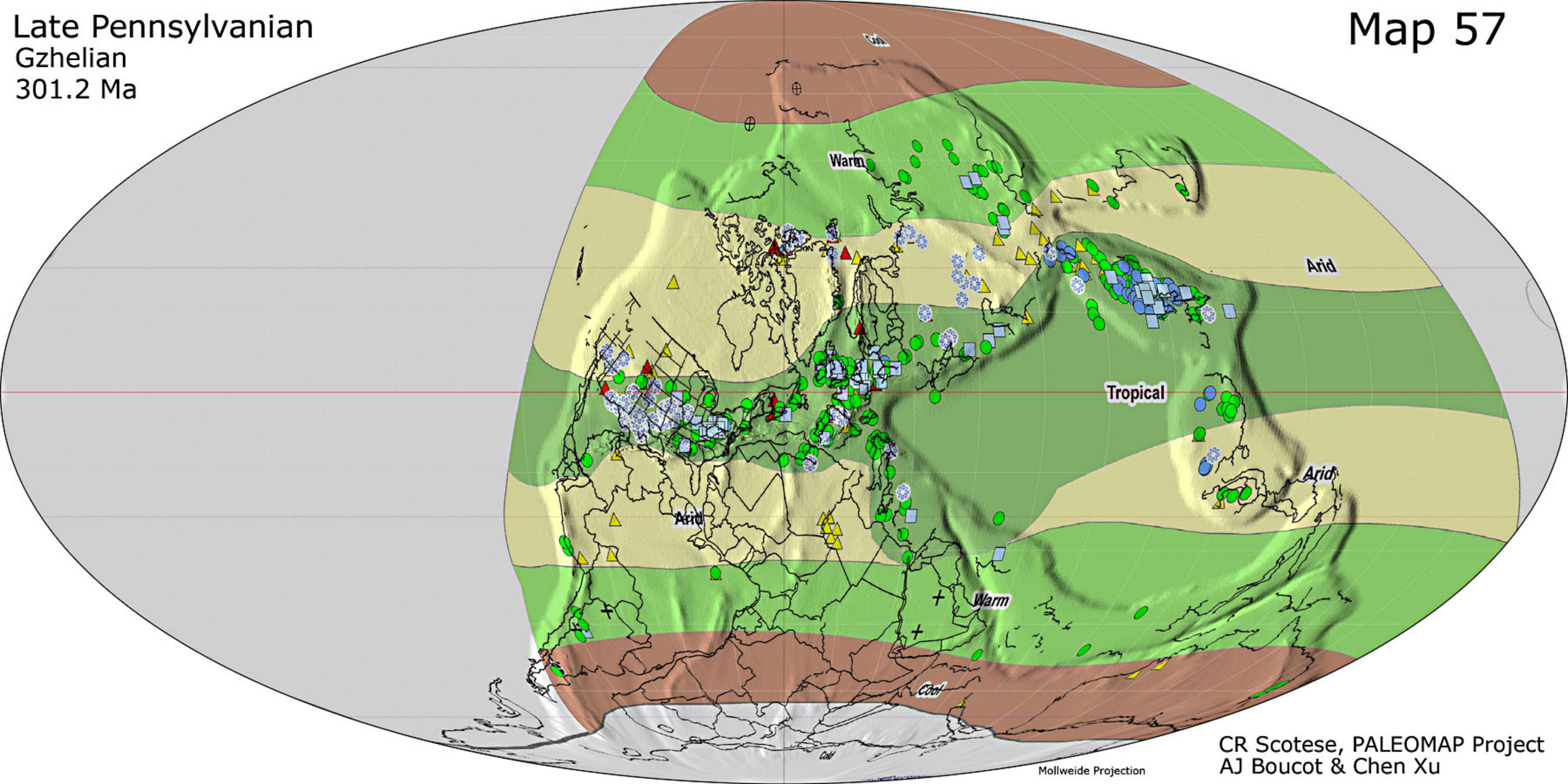
Early Permian
Sakmarian
289.5 Ma

Map 55

Map in Preparation

Late Pennsylvanian
Gzhelian
301.2 Ma

Map 57



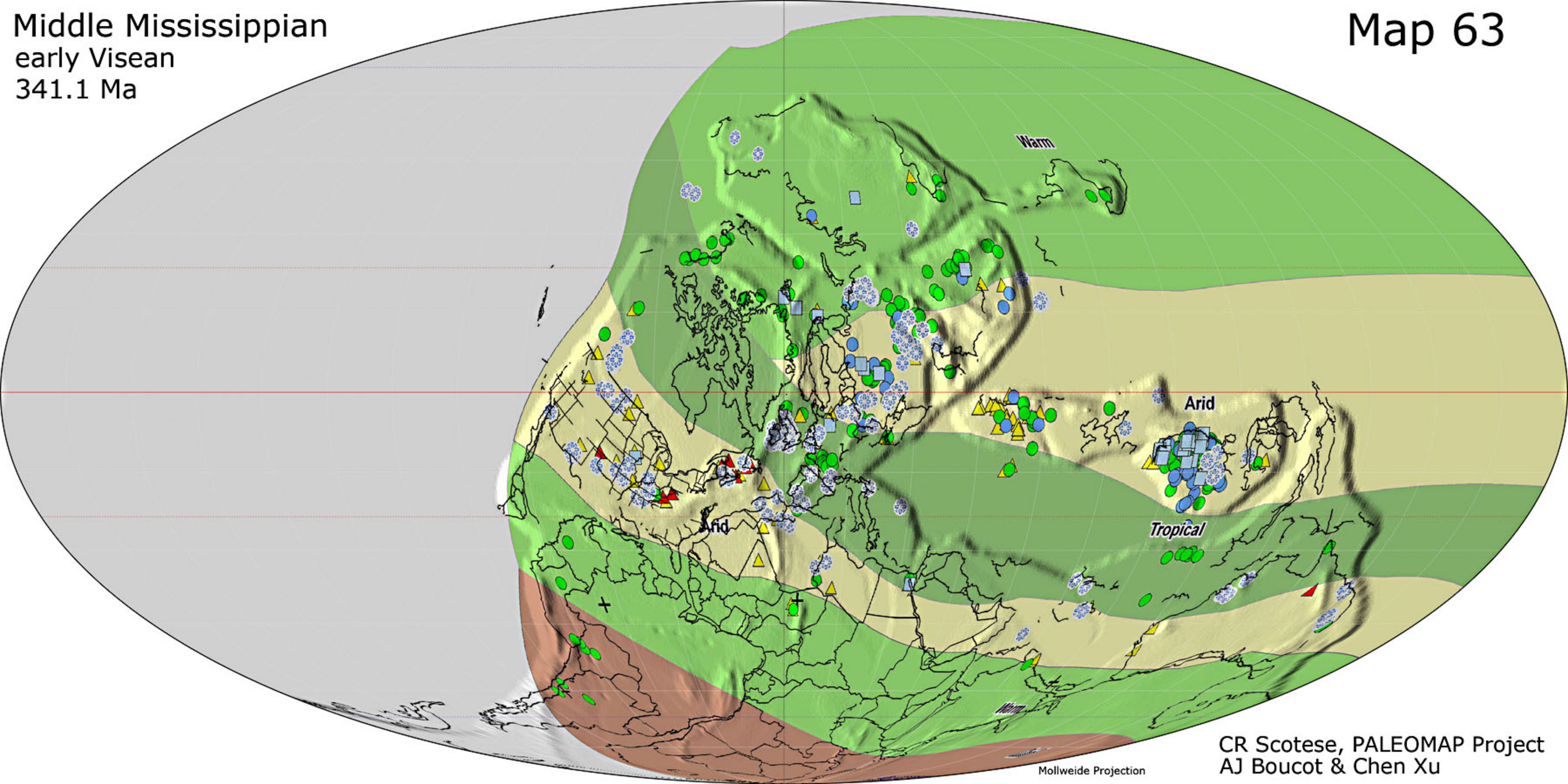
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Map 61



Middle Mississippian
early Visean
341.1 Ma

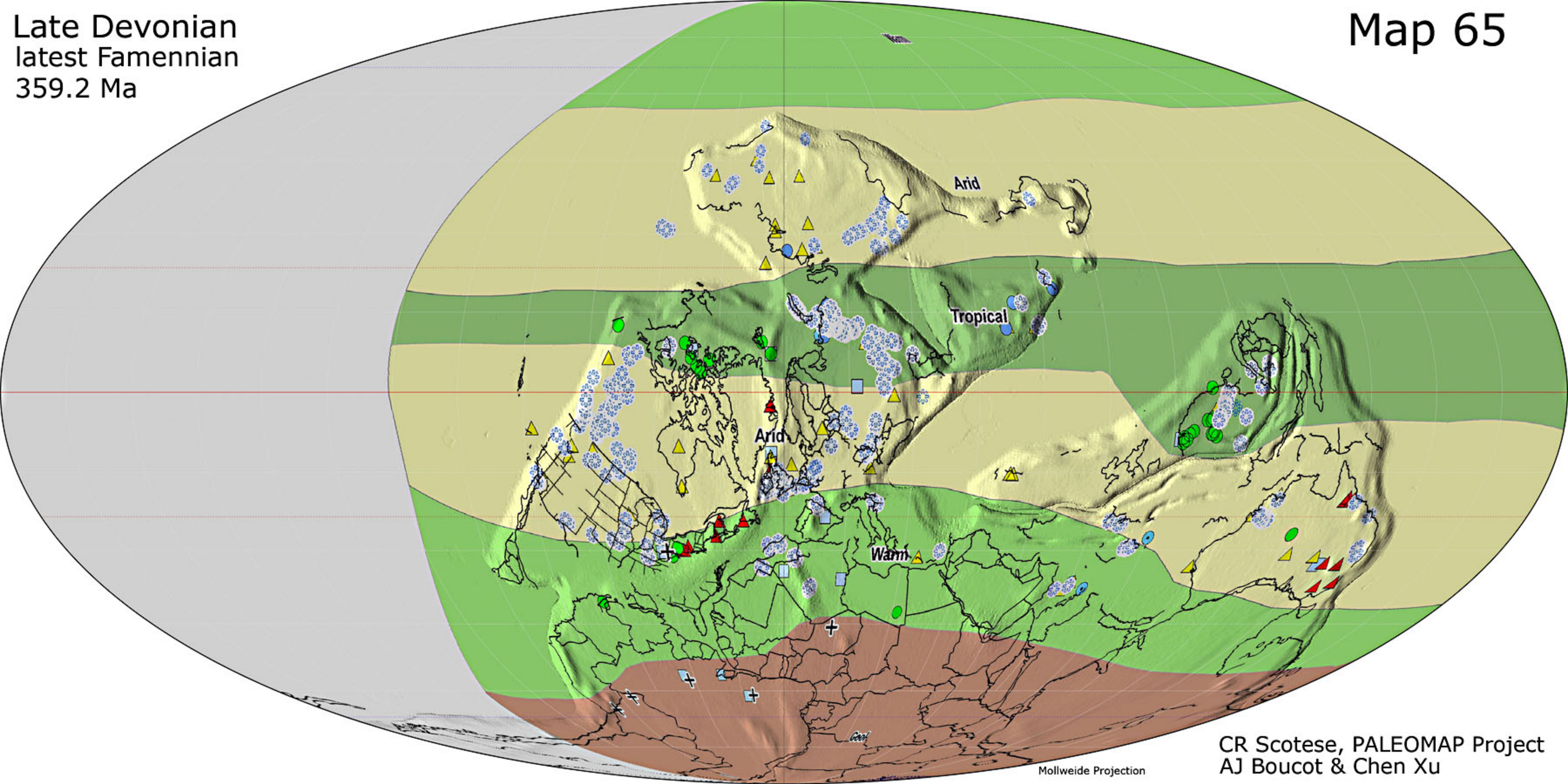
Map 63



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Late Devonian
latest Famennian
359.2 Ma

Map 65

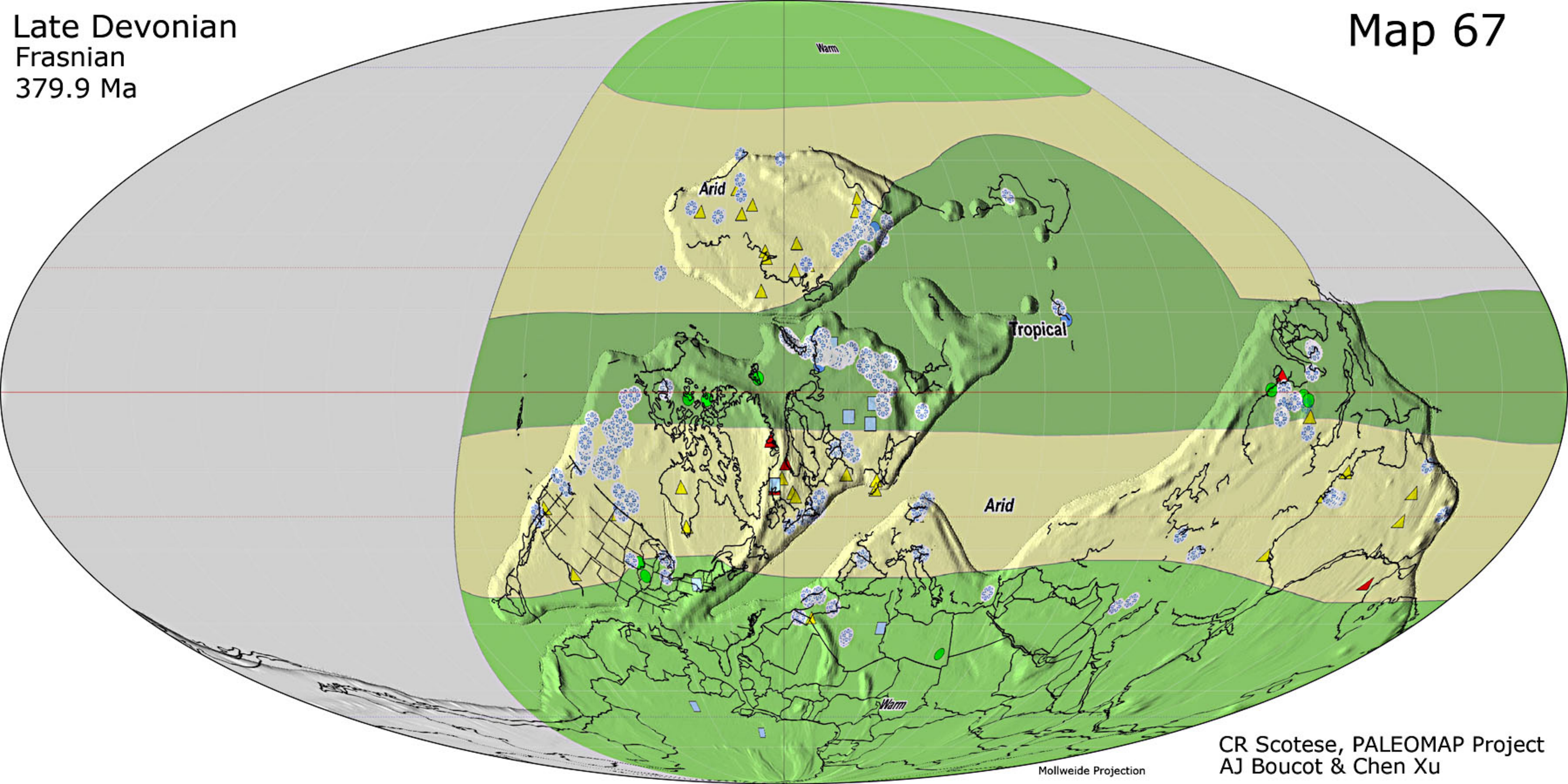


Mollweide Projection

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Late Devonian
Frasnian
379.9 Ma

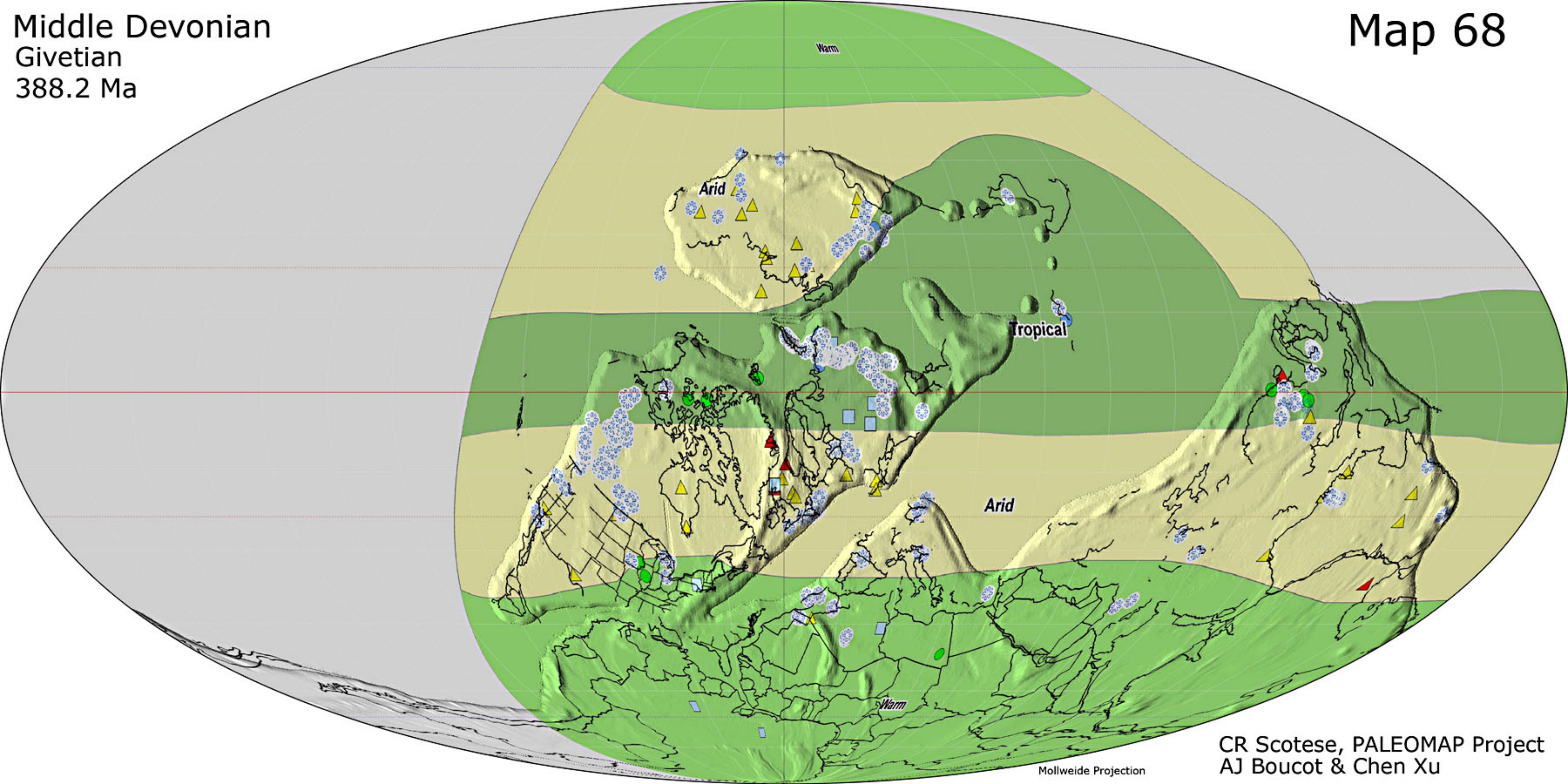
Map 67



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Middle Devonian
Givetian
388.2 Ma

Map 68

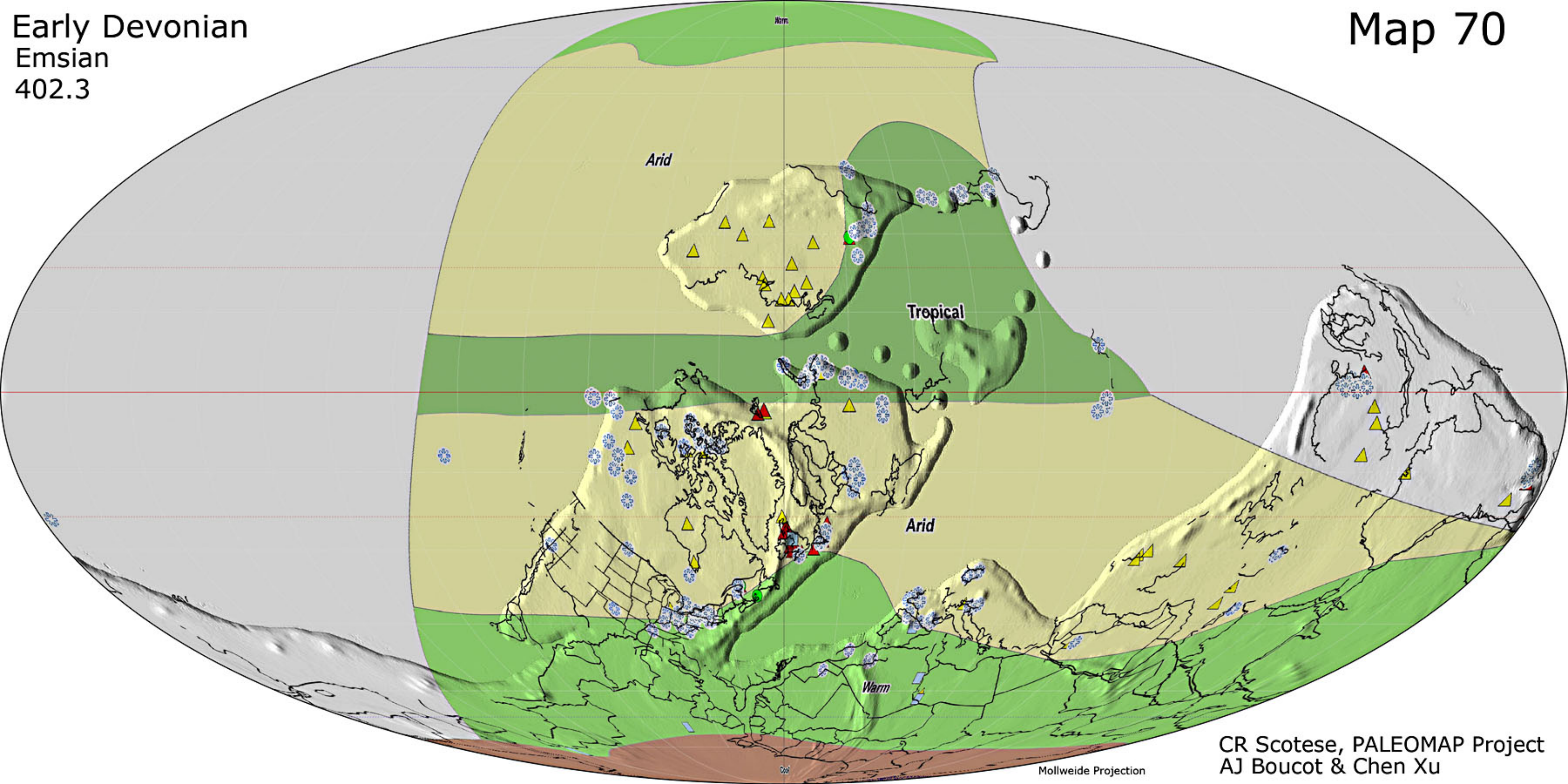


Mollweide Projection

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Early Devonian
Emsian
402.3

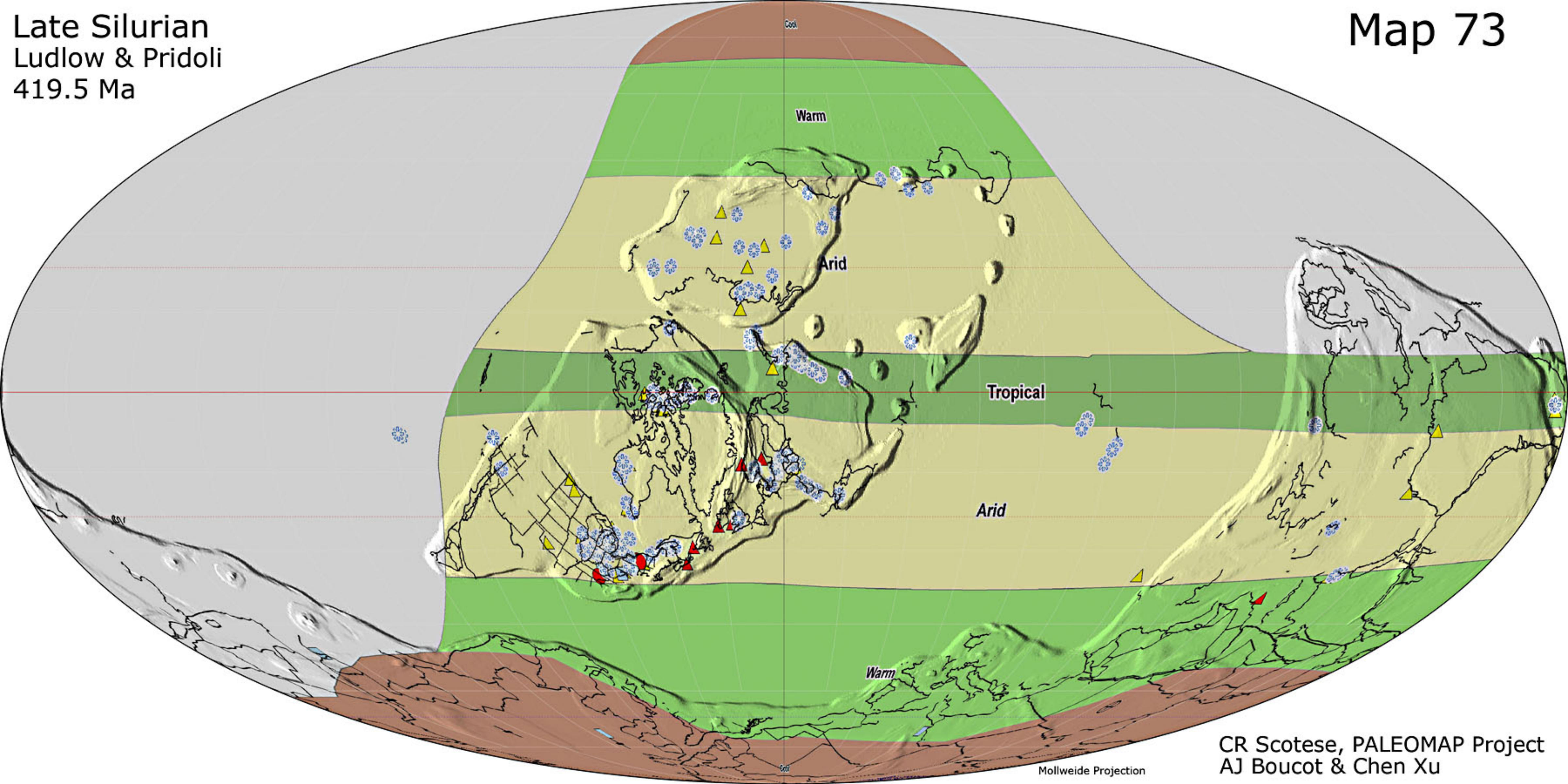
Map 70



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Late Silurian
Ludlow & Pridoli
419.5 Ma

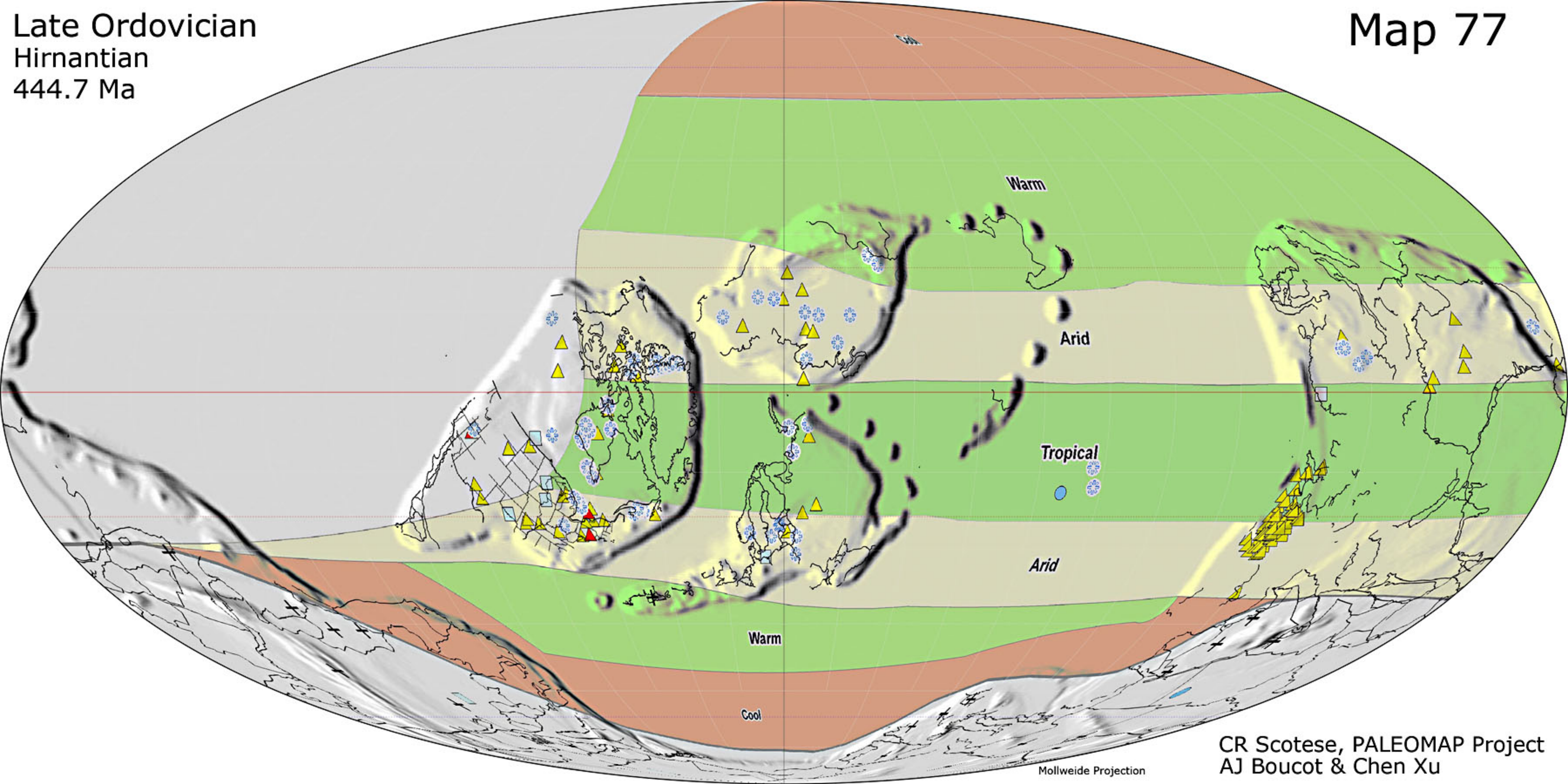
Map 73



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Late Ordovician
Hirnantian
444.7 Ma

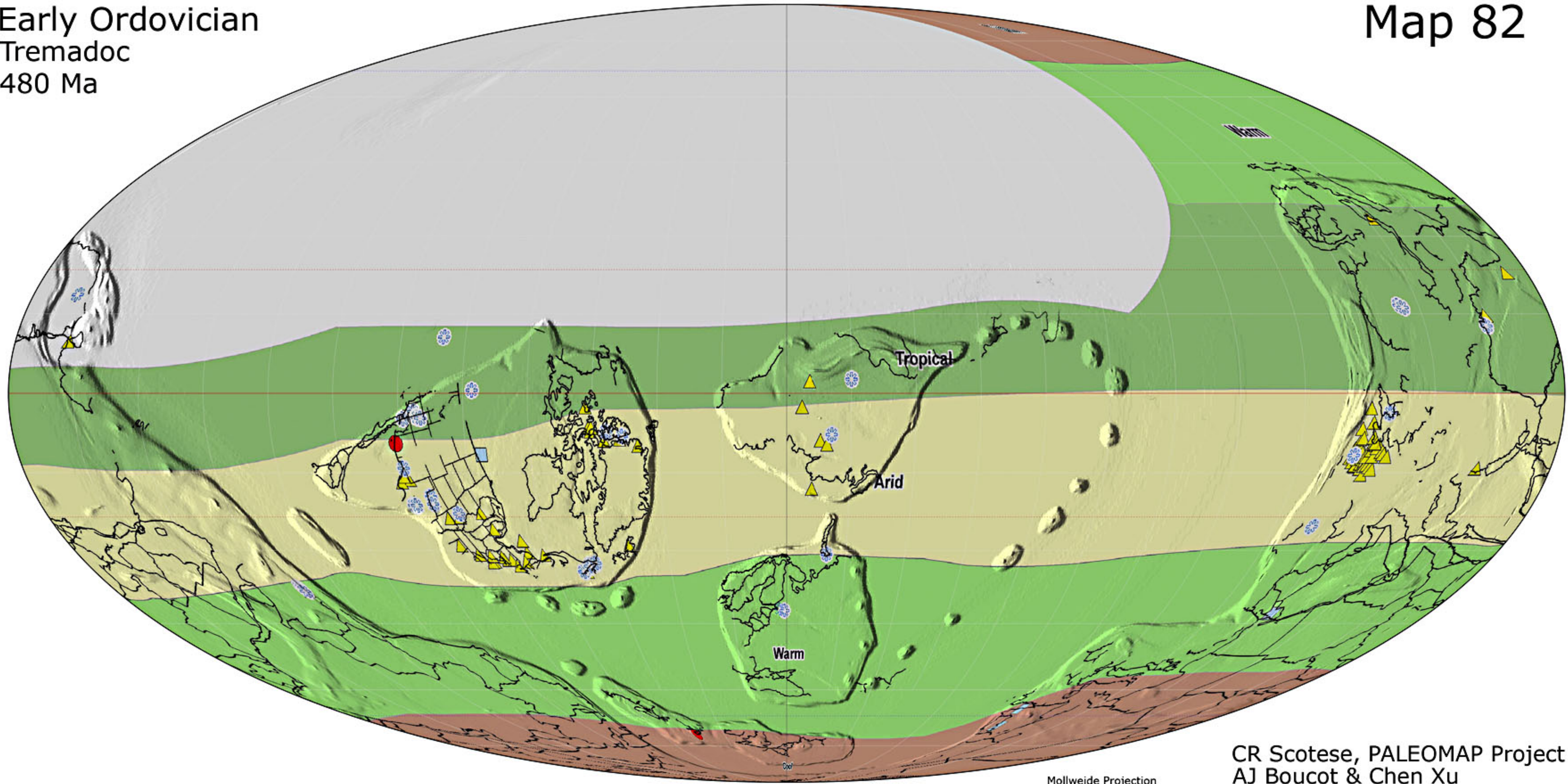
Map 77



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Early Ordovician
Tremadoc
480 Ma

Map 82

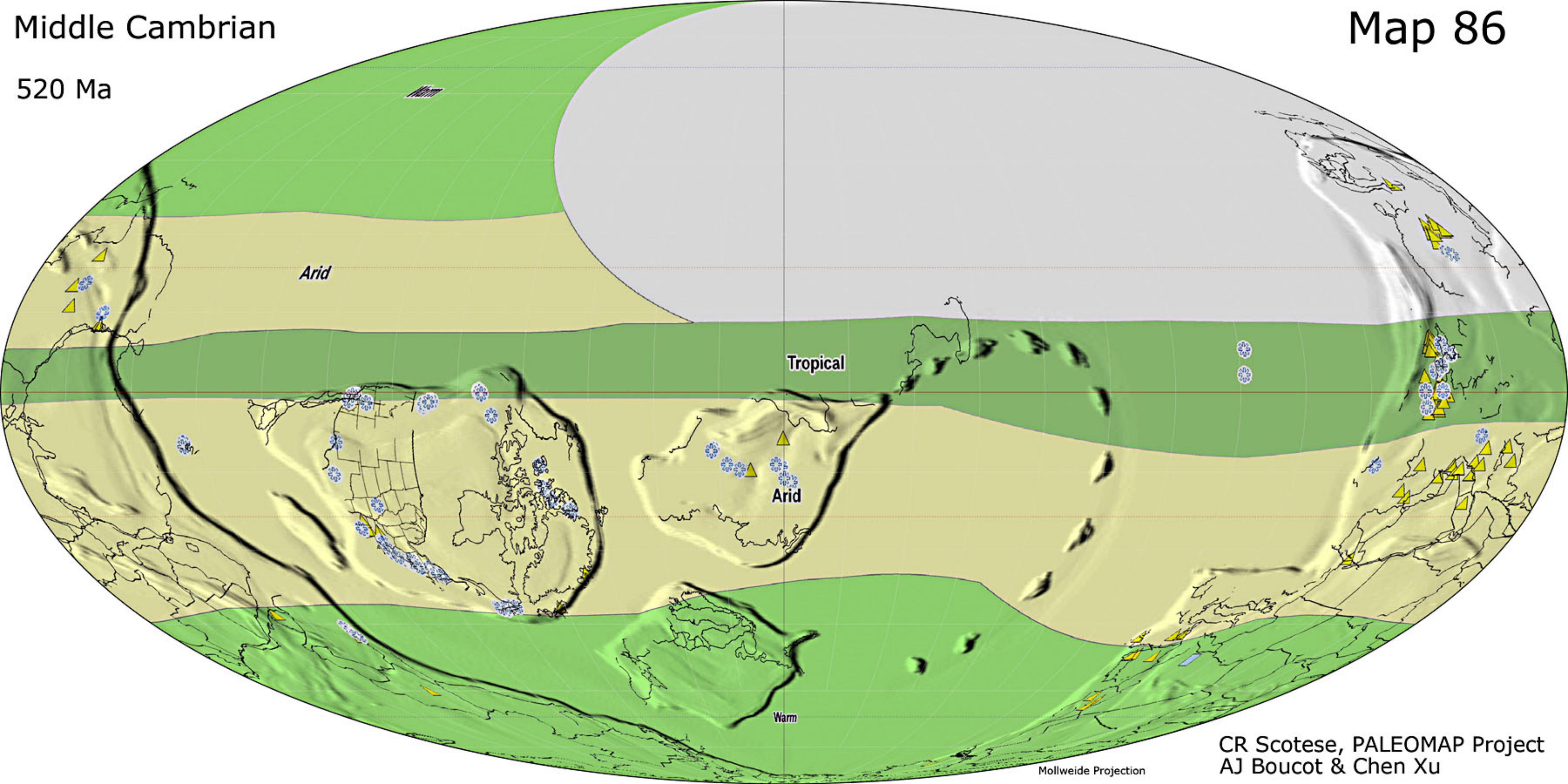


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Middle Cambrian

Map 86

520 Ma

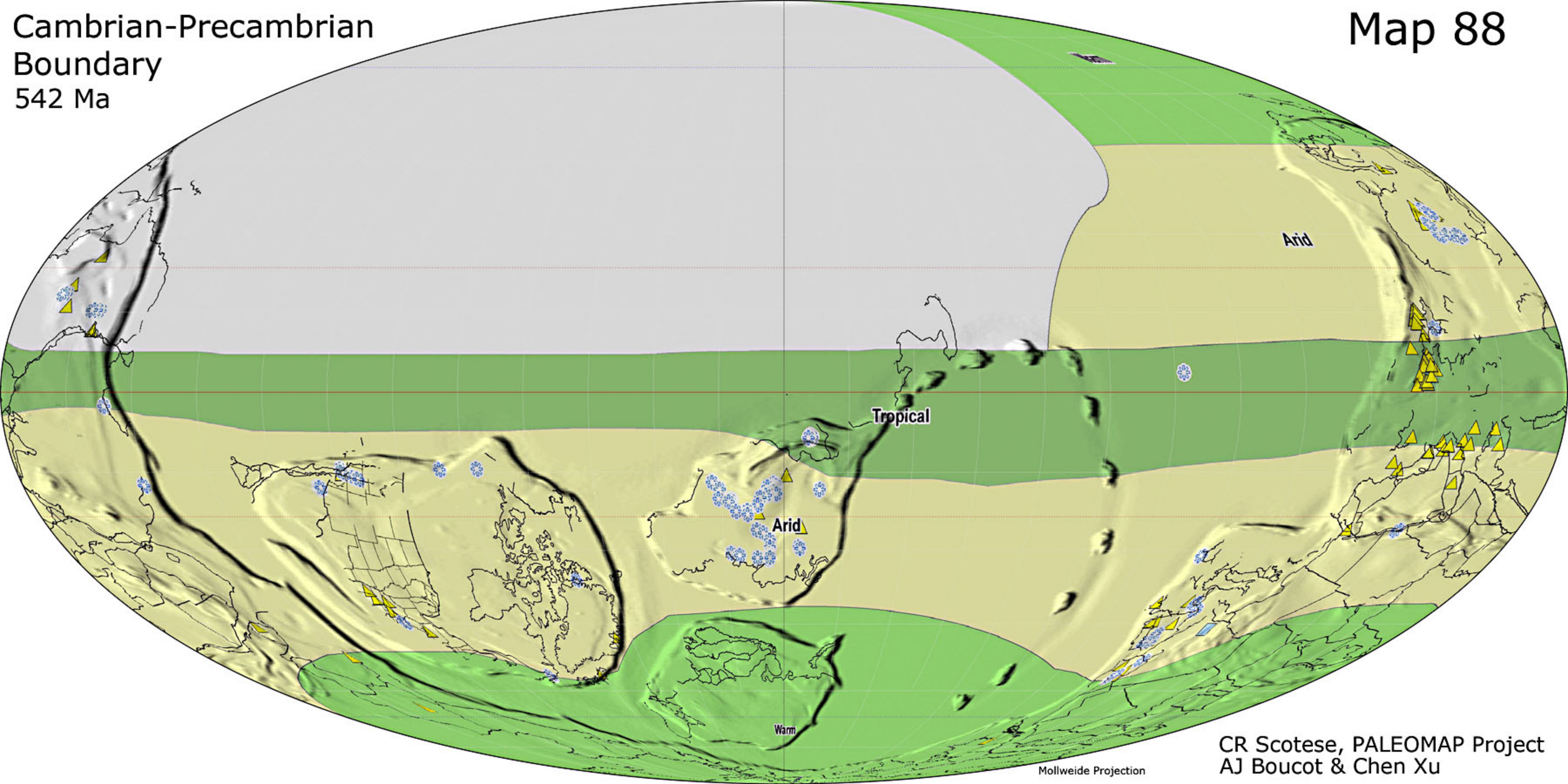


Mollweide Projection

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Cambrian-Precambrian
Boundary
542 Ma

Map 88



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