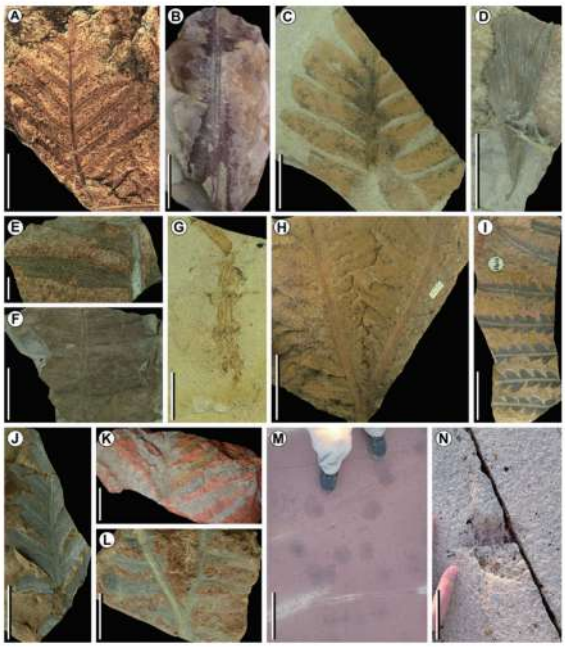
Permophiles

International Commission on Stratigraphy



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Henderson's Harangue #10

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It is time to 'finish' the Permian by defining the Kungurian - revisited!

As an attempt to stimulate debate or perhaps simply because something smells fishy, I deliver my tenth harangue. In Italian, it would be "L' arringa di Henderson" (the double "r" is important).

In my last harangue I talked about the base-Artinskian GSSP – it had been ratified by IUGS on February 1, 2022 and a revised manuscript was sent a few weeks later to Episodes to publish the result. The review of the manuscript had just begun when IUGS decided on March 1 to establish scientific sanctions against Russians for the invasion of the Ukraine. The result of these sanctions is that the GSSP manuscript sits in limbo. The path forward is not clear, but possibly greater emphasis on the comparison with a section at Carlin Canyon, Nevada might provide clarity. The path forward for the base-Kungurian GSSP seems to be clear. Until further notice, IUGS has advised that "active involvement of scientists from Russian institutions in IUGS groups and activities should cease". Fortunately there is an alternative section at Rockland, Nevada, USA (see *Permophiles* 56; p. 8-21). In this harangue I wish to highlight some plans for the Kungurian as well as discuss the process of 'doing' science in this crazy world.

This really is a crazy world with the covid pandemic, political instability, climate change, human migrations, runaway inflation, and military invasions. Tensions are rising and I do wonder about the fate of these negative trends, but hope that calmer minds prevail. Many of us are trying to find our own little bit of normal and science is one place where we often look. The pandemic has changed the way we do science – it has changed the way we work in our offices and laboratories and it has changed the way we collaborate and communicate. As geologists we understand that change is normal and some change can be very positive. It is much more restrictive, difficult and costly to travel to other countries, but we can talk to each other easily and often via Zoom at no cost. It means we can continue to make geoscientific progress at least until the samples, currently collecting dust in our laboratories, have been fully studied. Is there a geologist who doesn't have extra samples lying around?

SPS has previously determined that two GSSP candidates have priority for defining the base-Kungurian; see two articles in *Permophiles* 56 (Chernykh et al., 2012; Henderson et al., 2012). The first is at the Mechetlino section in Russia and the second is at the Rockland section in Nevada USA. Those two articles, highlighting results from two distant regions, prove the wide correlation potential of the chosen point (*ie*. the FAD of *Neostreptognathodus pnevi*). Numerous additional correlation tools are discussed in these articles, including strontium isotopes. One of the key characteristics of any GSSP is the open and free access to the site for scientific study. The Russian-Ukraine war has negatively impacted the open and free access to the Mechetlino section for the moment and, in all likelihood, for some time to come after the war has ended. Therefore, SPS is directing and concentrating its effort to define the GSSP at the Rockland section in Nevada. What do we need to do? One limitation was the Sr isotopic excursion noted in figure 8 (p. 15 of *Permophiles* 56) was only extrapolated to the GSSP level. This excellent research was part of the PhD dissertation of Kate Tierney. Fortunately, Kate has some samples stored at the University of Iowa and has agreed, with some support from SPS, to start drilling those samples to complete the curve through the GSSP level. We also need to consider access and protection of the site. The site is on Bureau of Land Management forestry land and is therefore freely accessible. In addition, a recent ruling by the BLM means that conodont samples can be collected free of permit. The site is accessible by a gravel road 38 km south of the I-80 highway, followed by a 2.3 km hike with elevation gain of 580 metres (starting at 5750 feet and ending at 7650 feet elevation). In other words some effort and reasonable level of fitness is required to get to this site in the Basin and Range province of Nevada. The potential GSSP location is at 40.77904°N and 114.60604°W and is illustrated in *Permophiles* 56; you can check out the location on Google Earth. Some effort will need to be made to improve the site, including signage. I have contacted some American colleagues and hope to contact BLM officials and the mining industry; I will continue to make this effort in advance of a SPS field workshop, currently planned for May, 2023. I appreciate any advice on this matter.

There is one other area in northern Nevada that is pertinent to the base-Artinskian and likely the base-Kungurian – this area is Carlin Canyon, near the town of Carlin. Gold deposits referred to as Carlin-type gold are mined nearby. For me, Carlin Canyon became a site of our University of Calgary senior-level field school in 2010. Through the efforts of field school students, two BSc theses, and a MSc thesis, my colleague Benoit Beauchamp and I have mapped and sampled a 4X5 km area extensively. This research followed earlier detailed work by Walter Snyder (Emeritus Boise State) and the late James H. Trexler Jr. The history of this research and new results are detailed in Beauchamp et al. (coming soon in 2022). Some results at Carlin Canyon have been compared to recent GSSP proposals (base-Sakmarian and base-Artinskian). Carlin Canyon could also be a location for the base-Kungurian, but to date we have only sampled as high as near the Artinskian-Kungurian boundary. Benoit Beauchamp, Lucia Angiolini, at least two students, and myself plan to visit and sample in mid-October.

In conclusion, this is not so much a harangue, but rather a plea for cooperative and collaborative action. By completing the last of our Permian GSSPs we set a defined template for important work that considers correlation into continental successions and other regions like Gondwana (see elsewhere in this issue). Can we do this in 2023 or early 2024? Say "yes".

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Subcommission on Permian Stratigraphy Working Group: Gondwana to Euramerica correlations

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The Subcommission on Permian Stratigraphy (SPS) has always had very active working groups that consider challenges and opportunities that the Permian community thinks are important. At present there are three working groups in SPS. The Artinskian-base and Kungurian-base GSSP Working Group, the Carboniferous-Permian-Early Triassic Nonmarine-Marine Correlation Working Group and the Correlation between marine and continental Guadalupian Working Group.

Fig. 1. Apillapampa outcrop at Quebrada Chullpanimayo. Chullpanimayo stream bend #4 showing highly fossiliferous limestone and shale (see Table 1 for references), vertically bedded Copacabana Formation turbidites in the basal Pc5 Sequence (shaley marine ramp lithozone). View is to the south; up-section is to the right; Charles Henderson and Vladimir Davydov for scale. Photograph taken during medium water level, March 2007. A thick ignimbrite marks the end of deposition of coaly and carbonate rocks and the beginning of deposition of sandstones and cherty mudstone of the Vitiacua Formation (from di Pasquo et al. 2015).

At recent meetings of the SPS, it was considered that a challenge for Permian science is the difficulty of correlating between Gondwana and Euramerica. This is particularly acute when important Gondwana successions are to be correlated with the 'standard sections' (including GSSPs) in Russia, the US and China. The SPS Executive therefore recommended that a Working Group be set up and a list of possible members was suggested. The Working Group was first convened on 17th May with most of the suggested members present. A second meeting was held on 17 June when all members were present. The group has agreed to have meetings around every two months or so to begin with, but also encourages meetings of sub-groups, for example, of palynologists, conodont specialists or brachiopodologists. The group has tried to maintain a good balance of men and women and representation of the main Gondwana and Euramerica continents.

So far, the meetings of the group have settled on three main aims for the WG:

1. To work on key sections for correlation where rock successions contain combinations of fossils that are particularly useful for correlating between Gondwana and Euramerica. Field visits and joint sampling may be part of this work.

2. To work on the taxonomy of some key species for Gondwana to Euramerica correlations, for example so-called 'bridge taxa' that occur between or throughout different Permian provinces

3. Share knowledge through digital means, for example galleries of photographs and taxonomic notes (example the BGS Taxonomy online galleries: https://www.bgs.ac.uk/information-

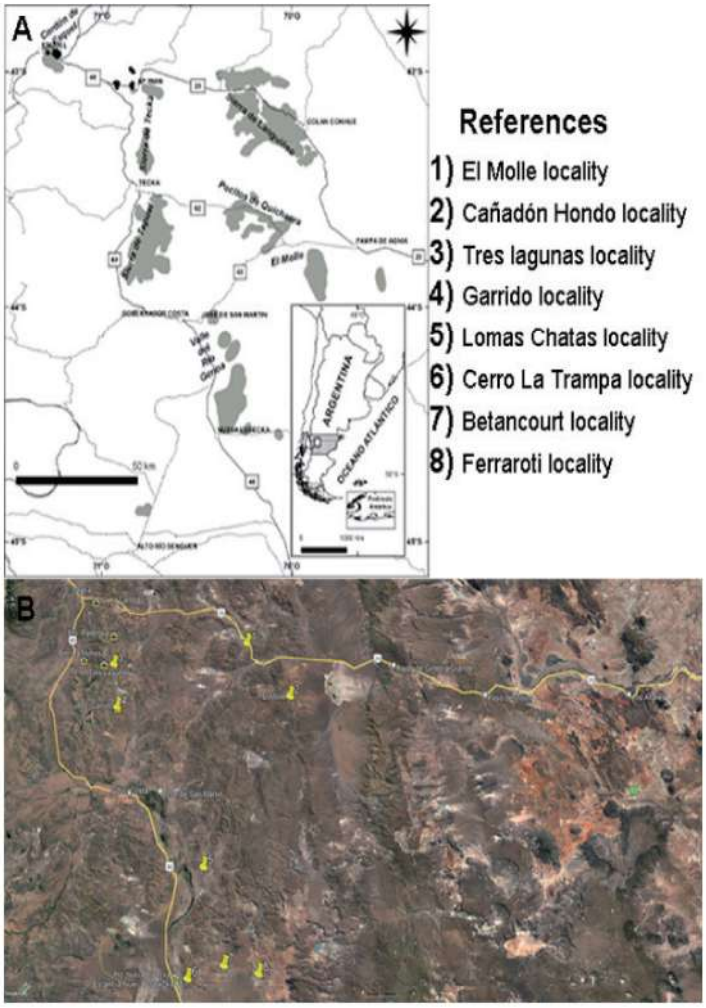

Fig. 2. Tepuel-Genoa Basin. **A**, location map; **B**, satellite image showing the key localities of Permian outcrops.

hub/data-collections/fossil-taxonomy/)

To decide on which key species and sections to work on, the WG has devised a proposal system whereby a member of the group proposes a key taxon or section through a short written proposal, which will be circulated before a meeting. This will help us choose the best sections and taxa.

So, the group is already quite active. We even have a WhatsApp account!

So far, the group has only considered (1) above in detail. Two key sections have been proposed, the Apillapampa section in Bolivia (Fig. 1) and sections in the Tepuel Group, Argentina (Fig. 2, 3). Some details of these proposed key sections are shown in Table 1.

The WG will continue to work on its aims and review its membership, and will report its progress regularly in Permophiles.

The members of the group are as follows (Table 2).

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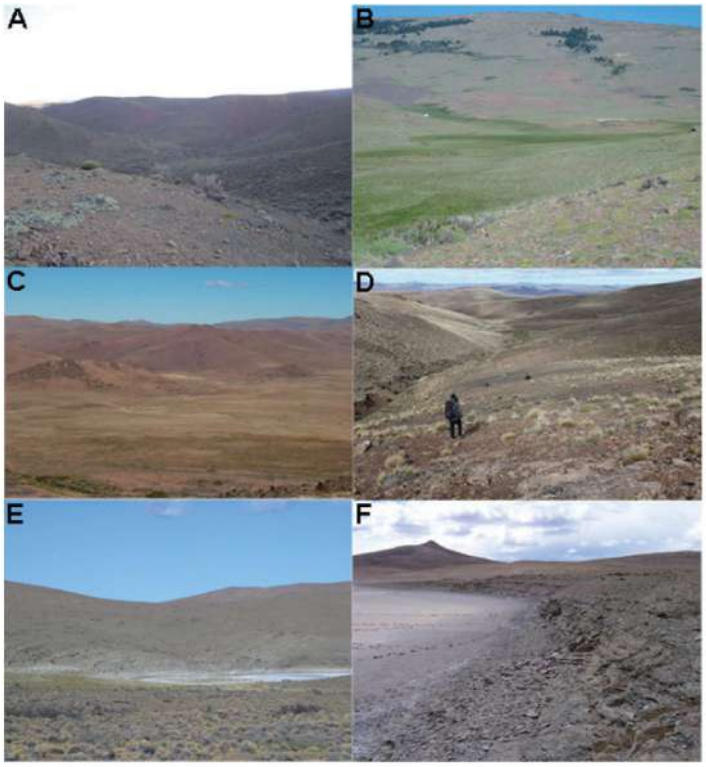

Fig. 3. **A**, general view of El Molle outcrops; **B–C**, general view of Tres Lagunas outcrops, B, lower levels, C, middle and upper levels; **D**, general view of Arroyo Garrido outcrops; **E**, general view of Betancort outcrops; **F**, general view of Ferraroti outcrops.

Table 1. Key sections for correlation proposed by the Working Group: Gondwana to Euramerica correlations.

Name of Section	**Why is it important that this section is considered by the Working group, or a subsection of the group**	**Key papers that discuss the section (max 5 papers) with links if possible**	**Precise location of section**
Apillapampa	Correlation between the paleo-equatorial province in which the Permian Stage GSSPs are based and Gondwana has been historically difficult mainly because the conodonts on which Permian Stage GSSPs are based (Henderson, 2018) are largely absent from Gondwana basins (Mouro et al., 2020; Scomazzon et al., 2013, Stephenson 2016). The Apillapampa section (Copacabana Formation) near Cochabamba, central Bolivia, is key to correlation between paleo-equatorial province and Gondwana because it contains conodonts, fusulinids and dated ash beds. Di Pasquo et al. (2015) quoted radiometric dates from six volcanic ash beds within the section; these dates were first cited by Henderson et al. (2009) based on analyses performed at Boise State University by Jim Crowley and Mark Schmitz. The six dates (cited as preliminary in Permian ICS Newsletter Permophiles, 53, Supplement 1) are 298 (40 m), 295.2 (120 m), 293.3 Ma (154 m), 293 Ma (185 m), 291.6 Ma (242 m) and 290.1 Ma (262 m) (Fig. 1). These dates are CA-ID-TIMS dates, but the precision has not been published yet. These zircons should be reanalysed using current tracers and statistical protocols. The dates fix the upper Coal Member of the Copacabana Formation as late Sakmarian to early Artinskian. The presence of the conodont *Sweetognathus* cf. *obliquidentatus* corroborates this correlation. *Sweetognathus whitei* and *Sw.* aff. *behnkeni* and the fusulinid *Eoparafusulina linearis* occur lower in the section; these taxa are typical of the late Asselian and early Sakmarian (Henderson, 2018; Petryshen et al., 2020; Chernykh et al., 2022 in *Permophiles* 72). Among the invertebrates, the high-diversity	Grader et al. (2008), Henderson et al. (2009), di Pasquo and Grader (2012), di Pasquo et al. (2015) (and previous references in those works) Base of section is located at 3043 m elevation with latitude 17.86669°S and longitude 066.24495°W.	17°30'00''S – 66°W, central Bolivia

	brachiopod fauna mentioned from the lower limestone of the Apillapampa section (Chamot, 1965), includes *Gypospirifer condor*, *Linoproductus cora*, *Waagenoconcha humboldti*, *Kozlowskia capaci* and *Rhipidomella cora*, which are key species for biostratigraphic correlations in South America, i.e. Bolivia, Perú and north-central Chile (Cisterna & Sterren, 2022), and which would also have been recorded from the northern hemisphere. The marine member of the Copacabana Formation displays cyclicity that may correlate with a long eccentricity signal. Our proposal suggests re-visiting and re-studying the fossiliferous groups present in the Cisuralian Copacabana Fm such as conodonts, fusulinids and plants and microfloras and invertebrates including common brachiopods along with isotopically-dated ash beds that can also be re-sampled. However, since only the palynology was fully revised, the brachiopods as the other groups would need further detailed study from new sample-collections. Current collections of conodonts (Henderson) and fusulinids (Davydov) need to be described and illustrated.		
Tepuel Group (Pampa de Tepuel Fm., Mojon de Hierro Fm. and Río Genoa Fm)	The Tepuel-Genoa Basin (Patagonia, southern Argentina) was infilled by nearly 7000 m of a continuous succession, from the Early Carboniferous (late Tournaisian) to the Early Permian (Artinskian). Lowermost Permian faunas were recognised in the upper part of the Pampa de Tepuel Formation and in the overlying Mojón de Hierro and Río Genoa Formation. The Permian exhibits an abundant and diverse record of fossil groups, being brachiopods, bivalves, bryozoans and gastropods the most representatives, together with subordinate occurrences of cnidarians, echinoderms, cephalopods, hyolithids, trilobites, ostracods, scaphopods and polyplacophors, but no conodonts. Absence of warm-water fossils coupled with several glacial-influenced horizons	Taboada (2008) Pagani & Taboada (2010) Taboada & Pagani (2010) Pagani & Taboada (2011) Taboada *et al.*, 2016 Taboada *et al.*, 2022	In central-west Patagonia, Late Paleozoic rocks extend over extensive areas between 43°–44° 20′S and 69° 30′–71°W, and are distributed from north–northwest to south–southeast for approximately 250 km.

	characterize the Tepuel Group, suggesting its faunal development in cold- to cool-water seas within high paleolatitudes (~70° S) and recording the most complete polar view of the Late Paleozoic Ice Age. The taxonomic composition of the Permian sequence in Patagonia suggests strong, but temporally varied faunal links with western Australia and the Cimmerian regions in south and southeast Asia, as well as moderate, but significant links with the Siberian Arctic region and, to a lesser extent, with eastern Australia. The key taxon are *Languigneotus dammanorum* Taboada *et al.* 2018; *Verchojania archboldi* Taboada, 2008; *Cimmeriella willi* Taboada & Pagani, 2010; *Costatumulus* sp.1; *Costatumulus* sp.2; *Costatumulus* sp.3; *Kochiproductus* sp.; *Tivertonia* sp.; *Jakutorpoductus sabattiniae* taboada & Pagani, 2010; *Jakutoproductus australis* Simanauskas & Archbold, 2002; *Piatnitzkya borreloi* Taboada, 1993 and *Magniplicatina* sp. The most important disadvantage of the Patagonia sequence is its paleogeographic position at high latitudes and the absence of warm-water fossils. However, the Permian sequence in Patagonia can be correlated with other sections in Gondwana, northeast Asia and the Arctic to establish global correlations. The bipolar or antitropical brachiopods provide a potential correlation to the Canadian Arctic (Bamber and Waterhouse, 1971), but these ages should be reevaluated based on new data and revisions to the Permian Time Scale. In this sense, the Tepuel–Genoa Basin in Patagonia is best positioned to serve as a possible reference area for Late Paleozoic Gondwana biostratigraphy as it possesses an excellently exposed and continuous succession containing diverse marine faunas and, in places, floras.		

Table 2 Members of the Working Group: Gondwana to Euramerica correlations.

Name	Location	Expertise
Gabriela A. Cisterna	CONICET-Instituto Superior de Correlación Geológica (INSUGEO), Tucumán, Argentina	Carboniferous and Permian brachiopods
Mercedes di Pasquo	CICYTTP - Centro de Investigaciones Científicas y transferencia Tecnológica a la Producción	Carboniferous and Permian palynology and paleobotany
Charles Henderson	University of Calgary	Permian conodonts
Pauline Kavali	Birbal Sahni Institute of Palaeosciences, India	Permian palynology
Alejandra Pagani	Museo Paleontologico Egidio Feruglio, Trelew Argentina - CONICET	Permian molluscs, brachiopods and bryozoa
Ana Karina Scomazzon	Universidade Federal do Rio Grande do Sul, Brazil	Permian and Carboniferous conodonts
Mike Stephenson (Chair)	British Geological Survey/Stephenson Geoscience Consulting Ltd	Permian and Carboniferous palynology
Liz Weldon	Deakin University Australia	Brachiopods, stratigraphy and palaeontology
Yi-chun Zhang	State Key Laboratory of Palaeobiology and Stratigraphy, Nanjing Institute of Geology and Palaeontology	Fusulinida

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Preliminary observations on Permian lithostratigraphy on the Mogollon Rim, Arizona, USA

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Introduction

Permian strata deposited on the western part of the Arizona shelf (a structural feature of the ancestral Rocky Mountains) are best exposed along the Mogollon Rim, the western edge of the Colorado Plateau in central Arizona (Fig. 1). Most of these strata are a thick (up to 550 m), red-bed-dominated section of the Supai Group (Formation) (e.g., Peirce et al., 1977, 1989; Blakey, 1979, 1990). Marine strata of the Naco Formation below

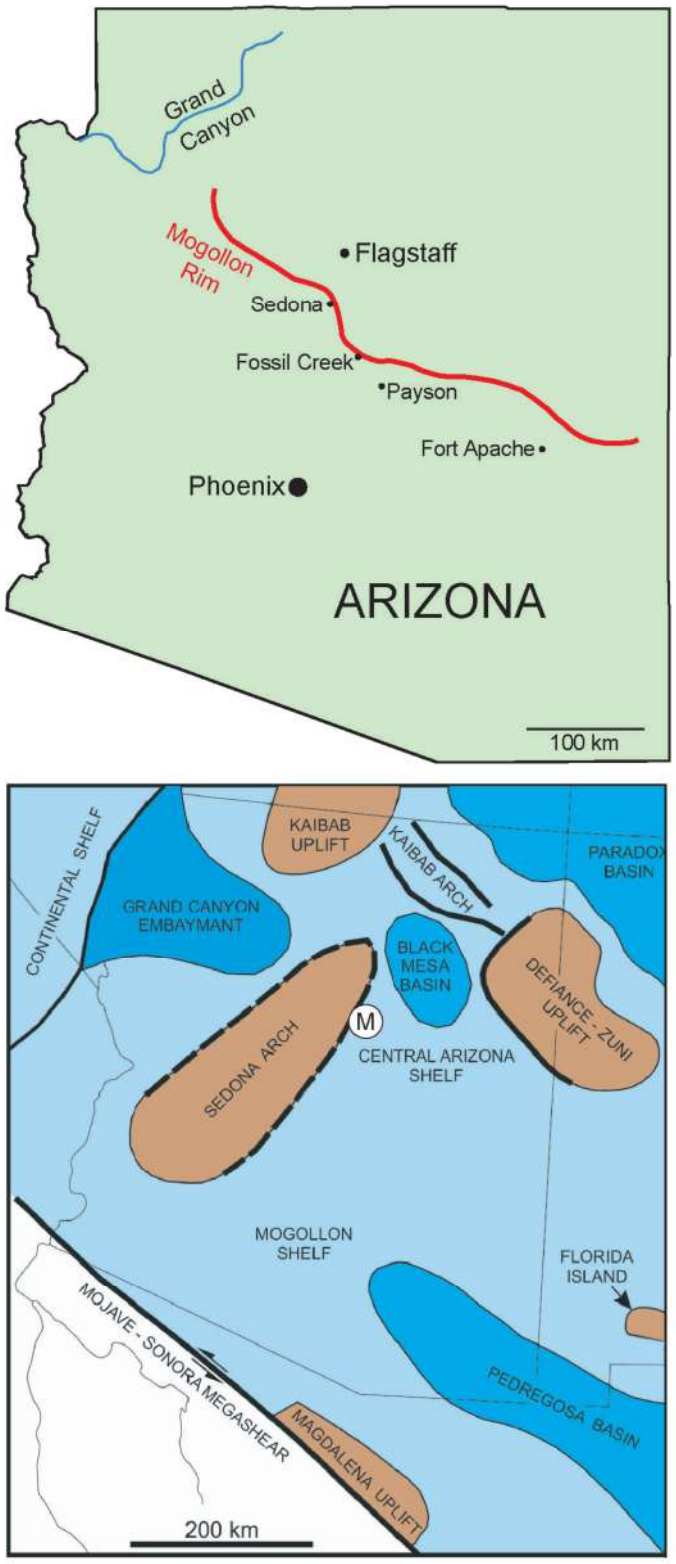

Fig. 1. Map of Arizona, USA, showing location of Mogollon Rim (above) and late Paleozoic paleo-tectonic map of Arizona; M = Mogollon Rim (below).