**Table S1.** List of major metriorhynchoid-bearing formations, and approximate coordinates. Note, some localities are listed as “NA” = not applicable, as paleolatitude.org could not compute their palaeolatitude due to the coordinates being located on an unconstrained plate.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Taxa** | **Stratigraphy and age** | **Locality** | **GPS coordinates and palaeolatitudes** | **References** |
| **Chile** | | | | |
| Metriorhynchoidea indet. | Uppermost of the Lautaro Formation.  Early Bajocian. | Quebrada de la Iglesia, Atacama | 28.17 S, 69.88 W  (27.31–36.54S for 170 Ma) | Gasparini *et al*., 2000; Pol & Gasparini, 2009; Soto-Acuña & Otero, 2014; Soto-Acuña *et al*., 2015a |
| “*Metriorhynchus*” *westermanni* | Quehuita Member, Quehuita Formation.  Early Callovian. | Quebrada Cherejara, Sierra del Medio, Antofagasta | 24.166 S, 68.667 W  (27–26S for 170–160 Ma) | Gasparini *et al*., 2008; Soto-Acuña *et al*., 2015a |
| “*Metriorhynchus*” *westermanni* | Mina Chica Fm., early-middle Callovian | Placilla de Caracoles, Antofagasta | 23.036S, 69.005 W  (26–25S for 170–160 Ma) | Gasparini, 1980; Soto- Acuña *et al*., 2015a |
| “*Metriorhynchus*” *casamiquelai* | Lower Member, Quinchamale Formation.  Middle Callovian | Quebrada Sajasa, Sierra Moreno, Antofagasta  Sierra Candeleros, Antofagasta | 21.875 S,  69.116 W  (25–24S for 170–160 Ma)  25.382 S, 69.368 W  (29–28S for 170–160 Ma) | Gasparini & Chong Diaz, 1977; Soto-Acuña *et al*., 2015a |
| “*Metriorhynchus*” aff. *westermanni* | beds with ‘*Perisphinctes*’ *andium*, Sierra El Cobre Formation. Oxfordian. | Cerro Laberinto, Cordillera de Domeyko, Antofagasta | 23.440 S, 69.344 W  (31–21 S (25.3 S for 160 Ma) | Fernández *et al*., 2011 |
| Metriorhynchidae indet. | beds with ‘*Perisphinctes*’ *andium*, Cerritos Bayos Formation. Oxfordian. | Cerritos Bayos, Calama, Antofagasta. | 22.617 S; 69.167 W  (30–20S (25)S for 160 Ma) | Soto-Acuña *et al*., 2015a, 2015b |
| ?*G*. *araucanensis*  Thalattosuchia indet. (Soto-Acuña *et al*., 2015a) | Lo Valdés Formation.  Tithonian | Lo Valdéz, Chile | 33.823 S, 70.052 W  (35–30S for 150–140 Ma) | Gasparini, 1985; Pol & Gasparini, 2009; Soto-Acuña *et al*., 2015a |
| **Argentina** | | | | |
| a thalattosuchian vertebra | Los Molles Formation.  Early Bajocian. | Chacaico Sur, southwest of the Neuquén Basin | 39.446 S, 70.305 W  (47.77–38.55S 42.93S for 170 Ma) | Pol & Gasparini, 2009 |
| *Metriorhynchus* aff. *M*. *brachyrhynchus*  Geosaurinae indet. | Middle to upper section of the Los Molles Formation.  Upper Bathonian | Chacay Melehue, located 27 km norrhwest of Chos Malal, Neuquén Province, Argentina | 37.224 S, 70.369 W  (41–40S for 170–160 Ma) | Gasparini *et al*., 2005; Pol & Gasparini, 2009 |
| *Cricosaurus araucanensis* | Portada Covunco Member.  Middle Tithonian. | Cerro Lotena and Bosque Petrificado (about 7 km to southwest of Cerro Lotena)  Yesera del Tromen-Pampa Tril (Tithonian-Berriasian).  Tithonian levels of Sierra de Reyes in Mendoza Province | 39.184 S, 69.654 W  (40–35S for 150–140 Ma)  37.238 S, 69.810 W  (38–33S for 150–140 Ma) | Gasparini & Dellapé, 1976; Herrera, 2015 |
| *Cricosaurus* *lithographicus* | *Aulacosphinctes proximus*–*Windhauseniceras intenispinosum* Biozones, Los Catutos Member, Vaca Muerta Formation.  Upper lower–middle upper Tithonian. | El Ministerio quarry, Los Catutos Area, Neuquén Province | 38.853 S, 70.182 W  (40–35S for 150–140 Ma) | Herrera, Gasparini & Fernández, 2013; Herrera, 2015 |
| *Dakosaurus* *andiniensis* Vignaud & Gasparini, 1996 | Vaca Muerta Formation.  Tithonian–Berriasian  Levels. | Catan Lil, Barrancas River (Malargüe, Mendoza Province)  in Berriasian of Mallín Quemado area (Neuquén Province)  Tithonian of Yesera del Tromen-Pampa Tril area (Neuquén Province) | 36.481 S, 70.178 W  (37,5–32S for 150–140 Ma)  38.583 S, 70.083 W  (40–34S for 150–140 Ma)  37.238 S, 69.810 W (38–33S for 150–140 Ma) | Vignaud & Gasparini, 1996; Gasparini *et al*., 2006 |
| *Dakosaurus* cf. *D*. *andiniensis* | *Substeueroceras koeneni* Biozone, Vaca Muerta Formation.  Uppermost Tithonian to lowermost Berriasian. | Vega de Escalone locality (Neuquén Province) | 37.185 S, 69.795 W  (38–33S for 150–140 Ma) | Herrera, 2015 |
| *Purranisaurus* *potens* Rusconi, 1948a | *Substeueroceras koeneni* Biozone, Vaca Muerta Formation.  Upper Tithonian–lower Berriasian. | Arroyo del Cajón Grande, southwest of Malargüe Department, Mendoza Province | 35.894 S, 70.314 W  (37–32S for 150–140 Ma) | Herrera, 2015; Herrera *et al*., 2015 |
| Metriorhynchidae indet. and Geosaurini indet.; *Cricosaurus* sp. | Upper Tithonian, *Corongoceras alternans* Biozone; Upper Tithonian–lower Berriasian *Substeueroceras koeneni* Biozone | Arroyo Durazno and Arroyo Paulino | 35.08 S  69.75 W;  34.967 S, 69.817 W  (36–31S for 150–140 Ma) | Fernández *et al*., 2019 |
| *Cricosaurus* *puelchorum* Herrera *et al*., 2021a | lower part of the *Argentiniceras noduliferum* Biozone, Vaca Muerta Formation.  Lower Berriasian, | Arroyo Paulino cropping out on the right margin of the Paulino Creek, Mendoza Province, Argentina | 34.967 S, 69.817 W  (36–31S for 150–140 Ma) | Herrera *et al*., 2021a |
| **Colombia** | | | | |
| cf. *Cricosaurus* | *Sayonoceras verrucosum* Biozone, Rosa Blanca Formation.  Upper Valanginian. | Colombia | NA. overall low tropical latitudes | Larsson *et al*., 2012 |
| **Mexico** | | | | |
| Thalattosuchia indet.,  Metriorhynchidae indet. | Tecocoyunca group.  Callovian. | Cualác, Guerrero, Mexico | 17.788N 98.645W  (7–10N for 170–160 Ma) | Gasparini, 1992; Cadena-Rangel, 2015 |
| *Maledictosuchus* *nuyivijanan* Barrientos-Lara, Alvarado-Ortega & Fernández, 2018 | Sabinal Formation. Kimmeridgian | Llano Yosobe, near Tlaxiaco, Oaxaca, southern Mexico | 17.247 N, 97.695 W  (9–13N for 160–150 Ma) | Barrientos-Lara *et al*., 2018 |
| *Torvoneustes* *mexicanus* | Sabinal Formation. ?Kimmeridgian | 6 km to south-southwest from Tlaxiaco town, Oaxaca | ~ 17.214N, 97.679W  (9–13N for 160–150 Ma) | Wieland, 1910; Buchy, 2008a; Barrientos-Lara *et al*., 2016 |
| Geosaurini indet.(was *Dakosaurus* sp.) | La Casita Formation.  Kimmeridgian | San Juan de los Dolores, Coahuila | 25.431 N, 100.582W  (18–21N for 160–150 Ma) | Buchy *et al*., 2007; Buchy, 2008b; Young *et al*., 2012 |
| *‘Cricosaurus’* *saltillensis* | La Caja Formation.  Early Tithonian. | Sierra de Buñuelas, near Gómez Farías, Coahuila | 25.057N, 101.145W  (21–29N for 150–140 Ma) | Buchy *et al*., 2006, 2013 |
| *Cricosaurus* *vignaudi* | La Pimienta Formation.  Middle Tithonian. | Mazatepec, Puebla | 20.016N, 97.416W  (15–23N for 150–140 Ma) | Frey *et al*., 2002 |
| **Cuba** | | | | |
| *Cricosaurus sp.* | Oxfordian | Southern slope of the Sierra de Guasasa; Cuba | 22.653 N, 83.704 W  (NA) | Gasparini & Iturralde-Vinent, 2001, 2006; Young & Andrade, 2009 |
| Metriorhynchidae indet.; Thalattosuchia indet.; | Oxfordian | Puerta del Ancón, Sierra de Guasasa  Hoyo de la Sierra | 22.653 N, 83.704 W  22.664 N, 83.498 W  (NA) | Gasparini & Iturralde-Vinent, 2006 |
| **USA** | | | | |
| *Zoneait* *nargorum* | Weberg Member, Snowshoe Formation. Latest Aalenian or early Bajocian. | near the towns of Suplee and Izee, east-central Oregon, USA | 44.089 N, 119.392 W  (NA) | Buffetaut, 1979; Wilberg, 2015 |
| **Europe early-diverging metriorhynchoids** | | | | |
| *Pelagosaurus* *typus* | Whitby Mudstone Formation.  Early Toarcian. | Whitby area, Yorkshire, England | 54.48 N, 0.62 E  (42N for 180Ma) | e.g. Westphal, 1962; Benton & Taylor 1984; Young & Steel, 2019 |
| *Pelagosaurus* *typus* | Beacon Limestone Formation.  Early Toarcian. | Strawberry Bank, north of Ilminster, Somerset, England | 50.55 N 2.54 W  (38N for 180Ma) | e.g. Duffin, 1979; Pierce & Benton, 2006 |
| *Pelagosaurus* *typus* | Argiles à Poissons Formation.  Early Toarcian. | Curcy-sur-Orne, Normandy, France | 49.01N, 0.52W  (37N for 180Ma) | e.g. Eudes-Deslongchamps, 1864; Steel, 1973; Brignon, 2018 |
| *Pelagosaurus* *typus* | Sachrang Formation.  Early Toarcian. | Holzmaden area, Baden-Württemberg, Germany | 48.38 N, 9.31 E  (39N for 180Ma) | Westphal, 1961,  1962; Steel, 1973 |
| *Magyarosuchus fitosi* | *Grammoceras* *thouarsense* ammonite Biozone, Kisgerecse Marl Formation.  Late Toarcian | Nagy-Pisznice Hill, close to Békás-Canyon, Hungary | 47.42 N, 18.29 E  (NA) | Ősi *et al*., 2018 |
| *Opisuchus meieri* | Opalinuston Formation.  Early Aalenian. | Heiningen near Göppingen, Baden-Württemberg, Germany | 48.39 N, 9.38 E  (39–32N for 180Ma–170Ma) | Aiglstorfer *et al*., 2020 |
| ‘*Pelagosaurus’* *tomarensis* | uppermost Toarcian or the base of the Aalenian | Tomar, Portugal | 39.36 N, 8.25 W (30–25N for 180Ma–170Ma) | Ferreira, 1959; Telles Antunes, 1967 |
| *Teleidosaurus calvadosii* | *zigzag*–*progracilis* Biozones, Calcaire de Caen and Calcaire d’Ecouché Formations.  Lower–middle Bathonian. | Calvados and Ecouché, Normandy, France | 49.02 N, 0.15 E  (30N for 170Ma)  48.43 N, 0.73 W  (30N for 170Ma) | Eudes-Deslongchamps, 1866; Young *et al*.,2010; Hua, 2020 |
| *Eoneustes bathonicus*  *Eoneustes gaudryi* | Upper Bajocian–Middle Bathonian | Normandy, Burgundy, and Castellane, France.  Départements of Cote d’Or, Burgundy, and Alpes-de-Haute-Provence, France | 49.02 N, 0.15 E  (30N for 170Ma)  47.26 N, 4.47 E  (30N for 170Ma) | Mercier, 1933; Collot, 1905; Young *et al*., 2010 |
| **Europe Metriorhynchidae** | | | | |
| *Neptunidraco ammoniticus* | Rosso Ammonitico Veronese Formation. Lower-most Bathonian | Near Sant'Ambrogio di Valpolicella, Verona, Italy | 45.31 N, 10.50 E  (25N for 170Ma) | Cau & Fanti, 2011 |
| *Thalattosuchus superciliosus*  *Gracilineustes leedsi*  *‘Metriorhynchus’ brachyrhynchus*  *Tyrannoneustes lythrodectikos*  *Ieldraan melkshamensis*  *Suchodus durobrivensis* | Oxford Clay Formation. Middle Callovian. | Most specimens are known from the Peterborough area of the UK.  Some localities further south also bear metriorhynchids, such as near Melksham, Wiltshire. | 52.57 N, 0.24 W  (34–35N for 170Ma–160Ma)  51.37 N, 2.14 W  (32–34N for 170Ma–160Ma) | Andrews, 1913; Foffa *et al*., 2018; Young *et al*., 2013a, 2021 |
| *Thalattosuchus superciliosus*  *‘Metriorhynchus’ brachyrhynchus*  *Tyrannoneustes* sp. (NHMUK PV OR 47989)  *Suchodus durobrivensis* | Marnes de Dives Formation.  Upper Callovian and lower Oxfordian. | Falaises des Vaches Noire, Calvados, France | 49.18 N, 0.05W  (30–32N for 170Ma–160Ma) | Eudes-Deslongchamps, 1867-1869; Lepage *et al*., 2008; Young *et al*., 2013a |
| Metriorhynchidae indet. | lower part of the Lower Callovian | Lacha-pelle-sous-Aubenas village, Monts d’Ardèche UNESCO Global Geopark | 44.56 N, 4.37E  (27–29N for 170Ma–160Ma) | Riou *et al*., 2021 |
| cf. *Torvoneustes*  *Torvoneustes* sp.  cf. *Tyrannoneustes*  cf. *Thalattosuchus* *superciliosus*  Geosaurinae indet.  Metriorhynchidae indet. | Corallian Group.  Middle Oxfordian. | Coral Rag of Yorkshire (e.g., Malton, North Grimston), Headington, Quarry Fields, and Garsington Oxfordshire, Heddington of Wiltshire, UK | 54.14 N, 0.79 W  (37–38N for 160Ma–150Ma)  51.72 N, 1.16 W  (34–35N for 160Ma–150Ma) | Young, 2014; Foffa *et al*., 2018 |
| *Maledictosuchus riclaensis* | *Erymnoceras coronatum* ammonite Biozone, Ágreda Formation.  Middle Callovian. | ‘‘Barranco de la Paridera’’,  Ricla, Zaragoza, Spain. | 41.5° N, 1.4° W  (25–26N for 170Ma–160Ma) | Parrilla-Bel *et al*., 2013 |
| *Tyrannoneustes* cf. *lythrodectikos*, “Teleosauridae indet. teeth and fragmentary remains of *Steneosaurus* sp. and *Metriorhynchus* sp.” | Ornatenton Formation.  Middle Callovian. | Masloh quarry near the Lutternsche Egge hill in the Wiehengebirge, Germany  + Wallücke | ~52.1 N 8.3 E  (35–36N for 170Ma–160Ma) | Michelis *et al*., 1996; Waskow *et al*., 2018 [NB taxonomic ID of *T.* cf. *lythrodectikos* requires verification] |
| cf. *Tyrannoneustes*  ‘*Dakosaurus’* | Callovian-Oxfordian aged deposits that yield isolated tooth crowns | Numerous localities in Poland. Spanning north-to-south: Wapienno, Inowrocław, and  Ogrodzieniec | 52.5 N, 17.5 E  (38–38N for 160Ma–150Ma)  50.2 N, 19.3 E  (37N for 160Ma) | Young *et al*., 2013a |
| Metriorhynchidae indet. or *Dakosaurus maximus* | Kimmeridgian aged deposits | Czarnogłowy. Poland (museum specimens labelled Zarnglaff are from this locality) | 53.4 N, 14.5 E  (39–39N for 160Ma–150Ma) | Hoffmann, 2005;  Hoffmann & Bickelmann, 2008 |
| *Geosaurus* sp.  *Torvoneustes coryphaeus*  *Dakosaurus maximus*  Geosaurinae gen. et sp. (OUMNH J.1583)  ‘English rostrum’ (‘E’-clade)  *Plesiosuchus manselii*  *Torvoneustes carpenteri*  *‘Metriorhynchus’ palpebrosus* | Kimmeridge Clay Formation.  Early Kimmeridgian to early Tithonian (154-148 Ma) | Numerous localities across England,  UK. Spanning from Ely in the north, to Kimmeridge in the south | 52.2 N 0.1 E  (35–36N for 160Ma–150Ma)  50.6 N 2.1 W  (33–34N for 160Ma–150Ma) | Young *et al*., 2012, 2013b, 2014a, 2020b |
| *Dakosaurus maximus*  *‘Metriorhynchus’* cf. *palpebrosus*  *‘Metriorhynchus’* cf. *hastifer* (‘E’-clade)  *Gracilineustes acutus* | Marnes de Bléville and  Argiles d’Octeville Formations.  Kimmeridgian. | Numerous localities across Normandy, France. Most near Octeville-sur-Mer and Cap de la Hève | 49.3 N 0.1 E  (32–33N for 160Ma–150Ma) | Lepage *et al*., 2008; Young *et al*., 2012, 2020a |
| ‘Swiss rostrum’ (‘E’-clade) | Villigen Formation.  Lower Kimmeridgian. | Near Oberbuchsiten, Canton Solothurn, Switzerland | 47.1 N, 7.4 E  (NA) | Young *et al*., 2020a |
| Druegendorf ‘E’-clade geosaurine | Feuerstein and Wohlgeschichtete Kalke Formations.  Kimmeridgian. | Braunenberg, Baden-Württemberg and Drügendorf, Bavaria, Germany | 49.5 N, 6.5 E  (33–34N for 160Ma–150Ma)  49.8 N, 11.1 E (34–35N for 160Ma–150Ma) | Abel *et al*., 2020 |
| *Cricosaurus* *bambergensis*  *Cricosaurus albersdorferi*  *Cricosaurus suevicus*  *Cricosaurus elegans*  *Cricosaurus rauhuti*  *Rhacheosaurus gracilis*  *Dakosaurus maximus*  *Geosaurus giganteus*  *Geosaurus grandis* | Numerous formations, deposited in lagoonal or very shallow ecosystems (late Kimmeridgian to early Tithonian) | Numerous localities across the Franconian Alb, Germany. Most are from the Solnhofen-Daiting region. Spanning from Wattendorf in the north to Nusplingen in the south. | 50.0 N 11.1 E  (35N for 150Ma)  48.1 N 8.5 E  (33N for 150Ma) | Andrade *et al*., 2010; Young *et al*., 2012; Sachs *et al*., 2019, 2021; Herrera *et* *al*., 2021b |
| Swiss rhacheosaurin | Twannbach Formation.  Lower Tithonian | Near Evilard, Canton Bern, Switzerland | 47.1 N, 7.1 E  (NA) | Young *et al*., 2021 |
| cf. *Plesiosuchus manselii* | Tereñes Formation.  Kimmeridgian. | La Griega Beach, Asturias, Northern Spain | 43.5 N, 5.2 E  (29–29N for 160Ma–150Ma) | Young *et al*., 2012 |
| cf. *Plesiosuchus* | *Semiradiata* Biozone, middle Tithonian | Kyjov, Slovakia | 49.1 N, 20.5 E  (NA) | Čerňanský *et al*., 2019 |
| *Neustosaurus gigondarum* (nomen dubium) | Lower Valanginian | Gigondas, Département du Vaucluse, France | 44.1 N, 5.0 E  (26–29N for 140Ma–130Ma) | Raspail, 1842 |
| ‘*Cricosaurus*’ *macrospondylus* referred specimen | Lower Valanginian | Barret-le-Bas, Hautes-Alpes, France | 44.1 N, 5.4 E (NA) | Hua *et al*., 2000 |
| Plesiosuchina indet. | Lower Upper Valanginian | Escaouprès valley, Département des Bouches-du- Rhône, France | 43.3 N, 5.5 E  (NA) | Young *et al*., 2014b |
| *Geosaurus lapparenti* | Upper Valanginian | La Martre, Département du Var, France | 43.4 N, 6.3 E  (NA) | Debelmas & Strannoloubsky, 1956 |
| *Cricosaurus schroederi* | Lower Valanginian | Sachsenhagen, Lower Saxony, Germany | 52.2 N, 9.1E  (34–37N for 140Ma–130Ma) | Karl *et al*., 2006; Sachs *et al*., 2020 |
| *Enaliosuchus macrospondylus* (nomen dubium) | Lower upper Valanginian | Near Osterwald, Lower Saxony, Germany | 52.1 N, 9.3 E  (34–37N for 140Ma–130Ma) | Koken, 1883; Sachs *et al*., 2020 |
| Plesiosuchina? indet.  *Torvoneustes*? sp. | Late Valanginian | Blücher quarries at Štramberk area, Czech Republic | 49.59 N, 18.12 E  (32–35 N for 140–130 Ma) | Madzia *et al*., 2021 |
|  | | | | |
| cf. Plesiosuchina | Hybla Formation.  Lower-most Aptian | Rocca Chi Parra quarry, Montagna Grande area, Sicily, Italy | 37.909 N, 12.762 E  (NA) | Chiarenza *et al*., 2015; Sachs *et al*., 2020 |

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