



*Supplement of*

## **Artificial intelligence applied to the classification of eight middle Eocene species of the genus *Podocyrtes* (polycystine radiolaria)**

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## **Supplementary materials**

Table S1-S3 shows example accuracies and losses for different epochs for each dataset.

5 Table S4-S6 displays images of the test set from different parts of the world's oceans and how they were classified with all three predictive models formed by training the different sub datasets, which are the "S", "SC" and "SCUB".

Table S7 shows accuracy from the MobileNet neural network architecture from each run with "U" (unstacked) datasets, which was not included in this study, and the accuracy for each species.

10 **Table S1.** Loss and categorical accuracy for five epochs for the “S” dataset.

**S**

<u>Epoch</u>	<u>Loss</u>	<u>Categorical accuracy</u>
1	0,1607	0,9482
2	0,031	0,9901
3	0,0144	0,9964
4	0,0033	0,9989
5	0,0038	0,9984

**Table S2.** Loss and categorical accuracy for five epochs for the “SC” dataset.

**SC**

<u>Epoch</u>	<u>Loss</u>	<u>Categorical accuracy</u>
1	0,1134	0,9655
2	0,0024	0,9997
3	0,00042018	1
4	8,8924E-05	1
5	4,3747E-05	1

15 **Table S3.** Loss and categorical accuracy for five epochs for the “SCUB” dataset.

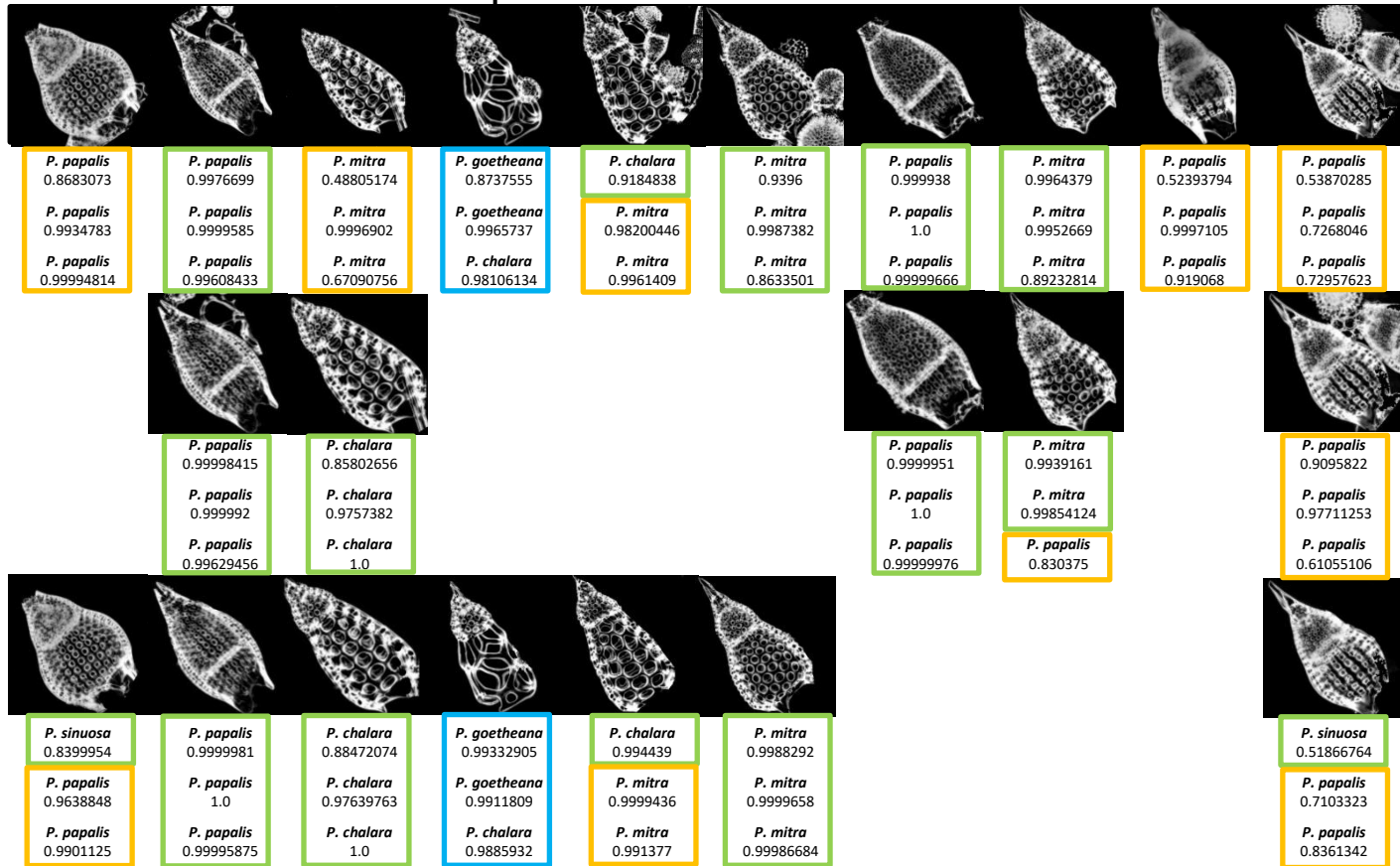
**SCUB**

<u>Epoch</u>	<u>Loss</u>	<u>Categorical accuracy</u>
1	0,1489	0,9513
2	0,03	0,9903
3	0,0162	0,9947
4	0,032	0,9895
5	0,0057	0,9986

**Table S4.** A variation of *Podocyrtes* species from ODP Leg 115 Hole 711A, Indian Ocean, classified with different predictive models, with and without cropping and removal of background particles.

# ODP Leg 115 Hole 711A (Madingley Rise, Indian Ocean)

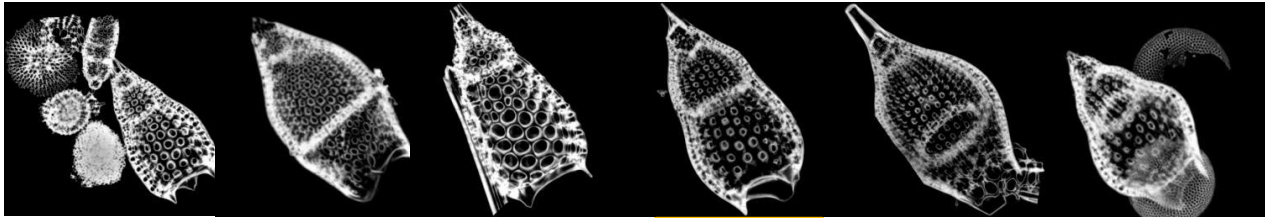
Intermediate form between *P. chalara* and *P. goetheana*



- Right species
- Intermediate form between two species
- Right neighbouring species
- Wrong species and neighbouring species

**Table S5.** A variation of *Podocyrtilis* species from DSDP Leg 95 Hole 612, western North Atlantic Ocean at the New Jersey slope, classified with different predictive models, with and without cropping and removal of background particles.

# DSDP Leg 95 Hole 612 (New Jersey slope, North Atlantic Ocean)



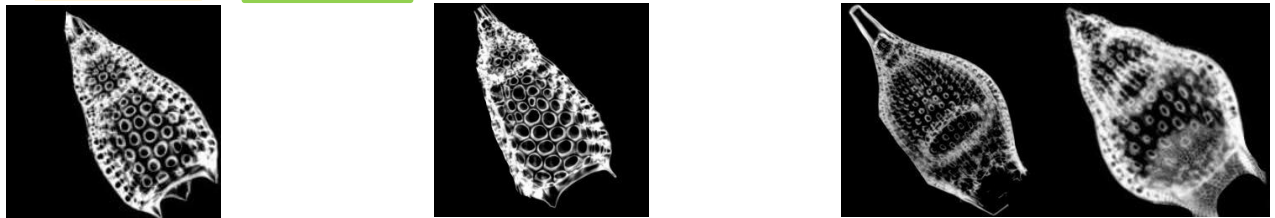
Predictive model (S)	<b><i>P. phyxis</i></b> 0.9982925	<i>P. papalis</i> 0.9999994	<i>P. mitra</i> 0.937046	<i>P. papalis</i> 0.53883487	<i>P. papalis</i> 0.9934343	<i>P. sinuosa</i> 0.99869484
Predictive model (SC)	<i>P. mitra</i> 0.9971181	<i>P. papalis</i> 0.99999464	<i>P. mitra</i> 0.9999999	<i>P. papalis</i> 0.9985304	<i>P. papalis</i> 0.9999635	<b><i>P. papalis</i></b> 0.99965787
Predictive model (SCUB)	<b><i>P. chalara</i></b> 0.994439	<b><i>P. sinuosa</i></b> 0.51866764	<i>P. mitra</i> 0.6862954	<i>P. mitra</i> 0.9848453	<i>P. papalis</i> 0.9951047	<b><i>P. sinuosa</i></b> 0.989205

## Cropped



Predictive model (S)	<i>P. mitra</i> 0.5506413	<i>P. papalis</i> 1.0				<i>P. sinuosa</i> 0.9049806
Predictive model (SC)	<i>P. mitra</i> 0.92830193	<i>P. papalis</i> 1.0				<b><i>P. papalis</i></b> 0.9975165
Predictive model (SCUB)	<b><i>P. papalis</i></b> 0.6063214	<i>P. papalis</i> 1.0				<b><i>P. papalis</i></b> 0.99996173

## Background removed



Predictive model (S)	<i>P. mitra</i> 0.6862954	<i>P. mitra</i> 0.9848453		<i>P. papalis</i> 0.9951047	<i>P. sinuosa</i> 0.989205
Predictive model (SC)	<i>P. mitra</i> 0.9565949	<i>P. mitra</i> 0.99931586		<i>P. papalis</i> 0.99999034	<b><i>P. papalis</i></b> 0.81359446
Predictive model (SCUB)	<b><i>P. papalis</i></b> 0.99842525	<i>P. mitra</i> 1.0		<i>P. papalis</i> 0.99997616	<b><i>P. papalis</i></b> 0.9992055

■ Right species

■ Right neighbouring species

■ Intermediate form between two species

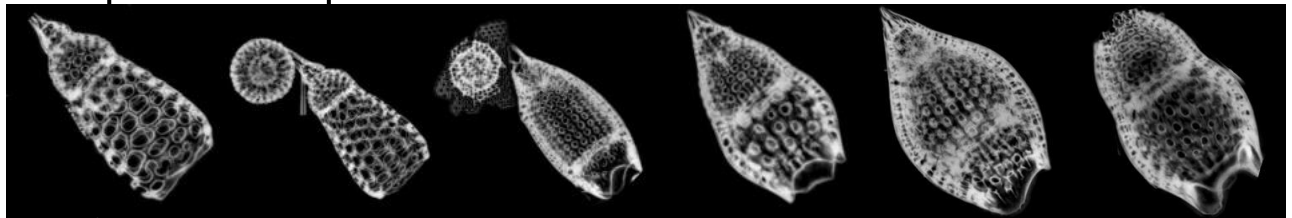
■ Wrong species and neighboring species

**Table S6.** A variation of *Podocyrthis* species from ODP Leg 171B Hole 1051A, western North Atlantic Ocean at Blake Nose, classified with different predictive models, with and without cropping and removal of background particles.



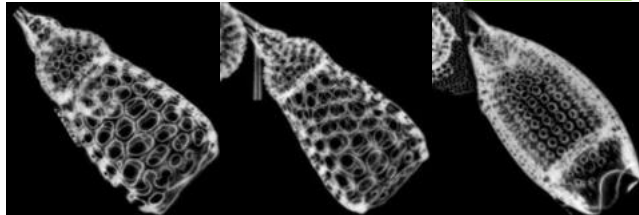
# ODP Leg 171 Hole 1051A (Blake Nose, North Atlantic Ocean)

Intermediate forms between *P. chalara* and *P. goetheana*



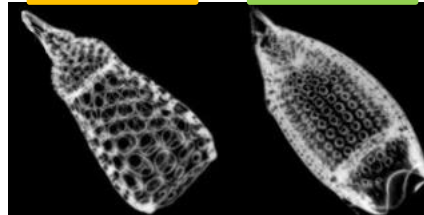
<i>P. mitra</i> 0.8955697	<i>P. phyxis</i> 0.8123627	<i>P. papalis</i> 0.86453533	<i>P. sinuosa</i> 0.97192603	<i>P. papalis</i> 0.9999889	<i>P. sinuosa</i> 0.92981154
<i>P. mitra</i> 0.9959792	<i>P. ampla</i> 0.799414	<i>P. papalis</i> 0.99987257	<i>P. papalis</i> 0.7703615	<i>P. papalis</i> 1.0	<i>P. sinuosa</i> 0.9127276
<i>P. chalara</i> 0.7979307	<i>P. goetheana</i> 0.86485523	<i>P. papalis</i> 0.99651885	<i>P. papalis</i> 0.8134036	<i>P. papalis</i> 0.9999999	<i>P. papalis</i> 0.820442

Cropped



<i>P. mitra</i> 0.9784138	<i>P. phyxis</i> 0.44186187	<i>P. papalis</i> 0.9999825
<i>P. mitra</i> 0.9996556	<i>P. ampla</i> 0.91096497	<i>P. papalis</i> 1.0
<i>P. chalara</i> 0.999134	<i>P. goetheana</i> 0.643032	<i>P. papalis</i> 1.0

Background removed



<i>P. phyxis</i> 0.4310236	<i>P. papalis</i> 0.9999535
<i>P. ampla</i> 0.9705439	<i>P. papalis</i> 1.0
<i>P. goetheana</i> 0.4427405	<i>P. papalis</i> 1.0

- Right species
- Intermediate form between two species
- Right neighbouring species
- Wrong species and neighboring species

**Table S7.** Precision for 10 runs and all species for the “U” dataset.

Run	<i>P. ampla</i>	<i>P. chalara</i>	<i>P. diamesa</i>	<i>P. goetheana</i>	<i>P. mitra</i>	<i>P. papalis</i>	<i>P. phyxis</i>	<i>P. sinuosa</i>	Average
1	42.86	97.96	92.00	80.56	0.00	69.86	91.30	27.27	65.02
2	62.50	100.00	96.77	11.11	26.67	91.03	18.75	58.82	58.30
3	100.00	100.00	92.31	92.68	98.00	98.67	94.74	95.83	96.82
4	100.00	100.00	94.59	100.00	64.29	93.06	72.73	64.00	86.93
5	100.00	82.35	31.25	100.00	40.74	100.00	0.00	52.00	68.20
6	93.75	82.35	37.50	100.00	77.27	100.00	86.36	78.57	83.75
7	15.38	90.91	100.00	16.67	0.00	84.34	76.19	0.00	20.85
8	100.00	100.00	100.00	96.43	98.11	35.53	94.12	62.50	79.51
9	45.45	66.67	93.10	95.24	68.75	52.31	78.26	95.83	67.14
10	100.00	95.65	39.29	96.88	98.08	100.00	91.67	90.91	91.52
Average	75.99	91.59	77.68	78.96	57.19	82.48	70.41	62.57	71.80