GeoArch

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Geophysical survey at Hendre'r Mynydd, Treherbert, Rhondda Cynon Taff

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Dr T.P. Young

Abstract

A geophysical survey was conducted over an E-W strip of land, 104m EW and 20m NS, within the scheduled area and spanning the gap between settlements I and II of the Garreg Lwyd/Blenrhondda/ Hendre'r Mnydd settlement site. Survey by magnetic gradiometer revealed no anomalies of certain archaeological origin. The Ground Resistivity Survey produced several anomalies that are probably indicative of additional drystone structures, two probable cairns, two probable extensions to exposed walling and two previously unmapped walls.

In the eastern 20m of the surveyed area, an unmapped wall (centred on [292271, 201910]) was parallel to two less certain linear anomalies, and possibly continued on the edge of the surveyed area to the SW of the modern track (an old Parish Road).

The central section of the survey contained a complex of resistivity anomalies, bounded to the east by a probable buried wall with a slight topographic expression (centred on [292247, 201906]). The presence of a linear positive anomaly to the NW of this, together with an abrupt linear NW boundary of the zone of complex anomalies, may hint tentatively at an unmapped enclosure, containing further possible features.

To the west of the area, two strong sub-circular positive resistivity anomalies are interpreted as being indicative of buried cairns. To the west of the cairns a largely stone-free area was probably underlain by peat.

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Methods

The site

The detailed survey area straddled the area between the exposed sections of the 'Garreg Lwyd unenclosed settlement II; Blaenrhondda ancient village group 'B'' to the east (NPRN 305644) and the 'Garreg Lwyd unenclosed settlement I; Blaenrhondda ancient village' to the west (NPRN 301342). The settlements are both included, together with the intervening open ground, within Scheduled Monument GM101 (Blaenrhondda settlement); the surveyed area lies entirely within the scheduled monument. Despite the names employed above, the site is more generally known as Hendre'r Myyndd.

The surveyed area was centred on [292230, 201910] and lay at approximately 460m OD. The sites lies on the Rhondda Member of the Pennant Sandstone formation of Bolsovian-Westphalian D (Upper Carboniferous) age.

Survey rationale and background

The surveys were conducted between the 19th and 22nd of October 2015. The work was undertaken as a public engagement project by the Glamorgan-Gwent Archaeological Trust (GGAT). Most of the resistivity survey and part of the topographic survey were accordingly undertaken by the volunteers, under the supervision of TY. The remainder of the surveys were undertaken by TY.

The survey was commissioned by Sophie Lewis of the Glamorgan-Gwent Archaeological Trust.

Survey layout and topographic survey
Surveys were laid-out using a Trimble survey-grade RTK GPS system (4700 base station and 5800 rover). A temporary base-station was created close to the modern path and the northern margin of the intended survey strip between the two settlements. GPS data were logged by the Trimble 4700 base receiver for 20 minutes on the first morning. The data logged were converted to RINEX format (using Trimble's '*RinexConvert*' utility) and were (together with RINEX files from the five closest OS passive net stations) backdated using the '*RinexDates'* utility to permit baseline processing in '*Trimble Geomatics Office'* (TGO). The OS data also required stripping from 10 to 7 included data types to ensure compatibility with TGO, using '*Teqc'*. The data files were then post-processed to give a location for the base-station accurate to within approximately 15mm.

The survey was then staked out, using the corrected base station location, to design locations at 'round-number' 20m intervals of National Grid using the Trimble 5800 rover. The grid pegs were positioned to within 40mm of the correct location reported by the GPS, which should mean they have a final accuracy to within approximately 50mm of National Grid.

The base-stations and the staked out grid locations are illustrated in Figure 1.

The same RTK system was employed for topographic mapping of features across the site. Point coordinates were gridded using kriging in Surfer to generate a fitted surface. Each significant stone visible on the surface was recorded by 3 or 4 points on its periphery. The margins of exposed drystone features were also recorded.

The old OS benchmark on the top of a boulder by the path to the north of the survey area was also recorded (as STN2: E,N,H = 292225.403, 201998.828, 469.641) to provide a suitable base station location for any future work at the site.

Ground resistivity
The ground resistivity survey was undertaken with a Geoscan RM15 resistivity meter, operating a 'parallel twin electrode' configuration, employing three electrodes with 0.5m probe spacing on a PA5 frame, via an MPX15 multiplexer.

In this configuration, the adjacent mobile electrode pairs had a 0.5m spacing (giving the main component of the response from 0.5-0.7m depth), with 0.5m between centres, to give a 0.5m effective traverse interval. The outer probes therefore had a 1.0m spacing (giving the main component of the response from 1.0-1.5m depth), with a 1.0m traverse interval.

Data were collected as a series of three measurements (left 0.5m-, right 0.5m-, 1.0m-spaced). Data were collected with a 0.5m sample interval (i.e. the raw 0.5m-spaced data has 0.5 x 0.5m node spacing and the 1.0m-spaced data has a 0.5 x 1.0m node spacing). Grids were walked on South to North traverses in a zig-zag pattern.

Data were downloaded from the instrument and collated using Geoscan Research's '*Geoplot*' software. The left and right datasets at 0.5m mobile probe spacing were merged into a single composite. Minor grid matching (balancing) was required to fit together some sections of the survey conducted with different remote probe locations.

Data processing was then mostly limited two passes of the 'despike' function in Geoplot, with radius set to 1 and a threshold of 3 std. dev. before replacement by the mean of adjacent points. For comparison, both datasets were also high-pass filtered in Geoplot, to remove some of the background variation.

Data were then exported from Geoplot and imported to Golden Software's 'Surfer'. The data were gridded by kriging to a node-spacing of 0.125m for production of the final, less pixelated, image.

Magnetic gradiometry
Magnetic gradiometry was undertaken with a Bartington Grad 601 Dual fluxgate gradiometer. Data were collected at 0.125m intervals on walked traverses 2m apart (giving effective traverse interval of 1.0m; single density). Grids were walked on South to North traverses in a zig-zag pattern.

Data were downloaded from the instrument, assembled and cleaned using DW Consulting's '*Terrasurveyor Lite v3*' software. The grids were assembled, the data clipped and the destriping function employed for data in which there was an imbalance between the two gradiometers. The raw data are illustrated in Figure 6.

The data were then exported from *Terrasurveyor* and interpolated to a 0.125m node-spacing using Golden Software's *Surfer* package to reduce pixilation where required. The interpolated and georeferenced data are illustrated in Figure 13.

Results

Topographic survey
The results of the topographic surveying are illustrated in Figure 2 (topographic contours and drystone features), Figure 3 ((topographic contours, drystone features, surface stones and observed breaks-of-slope).

Ground Resistivity
The raw data are illustrated in Figure 4a (0.5m-spaced data) and Figure 5a (1.0m-spaced data). Figures 4 and 5 also illustrate the balanced data (Figures 4b and 5b), the despiked data (Figures 4c and 5c), together with the high-pass filtered datasets (Figures 4d and 5d).

Final datasets are illustrated in Figures 7and 8 (for 0.5m-spaced electrodes) and Figures 10 and 11 (for 1.0m-spaced electrodes). The final high-pass filtered datasets are illustrated in Figures 9 (0.5m-spaced electrodes) and 12 (1.0m-spaced electrodes).

Data quality was generally good, with only minor striping as a result of imbalance between the left and right electrode pairs on the frame. Zones of elevated resistivity correlated closely with the distribution of exposed large stones (Figures 8 and 11).

The data divide into three main regions – a westerly zone with low resistivity (in part corresponding to a probable area of peat) and few exposed stones, a complex central area with an abrupt NW margin with raised resistivity, and an eastern area with moderately low resistivity, crossed by the modern path and containing several elongate zones of elevated

resistivity. The pattern of resistivity is broadly similar for the 0.5m- and 1.0m-spaced electrodes.

Magnetic gradiometry
Magnetic gradiometry results are illustrated in Figure 6 (Figure 6a raw data; Figure 6b destriped data) as images from *Terrasurveyor* and in Figure 13, as the final image from *Surfer*.

The data quality was moderately good, considering the problematic nature of the ground (uneven surface, partially buried boulders, tussocks of heather…) for conducting evenly-walked traverses.

There were very few minor 'ferrous spikes', sharp dipolar anomalies commonly associated with iron debris, although a few small anomalies occur in the area around [292272, 201906].

A series of moderately strong anomalies, mostly dipolar, occur across the area. Many of these coincide with the margins of exposed or buried stony areas, but it is unclear whether the anomalies might strongly magnetic rocks, or perhaps more likely, iron objects lost or discarded into the interstices of the stones.

In the SW corner of the survey area a very magnetically-quiet area corresponds to a region which appears to be covered in longer, wetter vegetation and is probably an area of peat (or similar). The margins of this peat area are surrounded by a zone of 5m width with elevated magnetic gradient. The coincidence of this zone with an area of scattered boulders suggests that the elevated magnetic gradient may possibly be associated with a stony subsoil.

Much of the survey area appears to show a slight NNE-SSW lineation, of which some more prominent examples are indicated in red on Figure 14.

Interpretation

The resistivity data include some strong positive anomalies that lie in continuation of visible features in the exposed drystone walling. Examples include an eastward extension of the southern end of the enclosure wall in the NW of 'Settlement II' (centred on [292282, 201917]) and a similar area west of a bulge in the thick walls at [292282, 201910].

Two further examples of walls were interpreted from both positive resistivity anomalies and exposed stones. The first, a SE-NW oriented anomaly centred on [292272, 201910] terminates to the SW in a possible facing oriented E-W. This wall lies on the upslope side of a distinct terrace in the hillside above the exposed structures to the SE. This probable wall is parallel to anomalies both the NW and SE that might possibly be further components of a structure including the central wall. All three of these potential features are truncated to the SW by the modern path – which follows the line of a Parish Road. The road is documented not only by the 1st Edition OS published in 1877, but also by the OS Preliminary Drawing (sheet 192) of 1814. Considerable amounts of stone lie on both sides of the path in this area, possibly indicating that the path construction involved the disturbance of stone. (although there is no indication that the path reached bedrock). A small area of elevated resistivity west of the path (centred on [292263, 201901]) might indicate a continuation of one of this group of features across the line of the path, but there is insufficient surveyed area of this anomaly to be certain.

The second probable example of a buried wall lies west of the path. The anomaly coincides with a slight, almost N-S, ridge and an array of large stones. Ridge, stones and anomaly all finish to the north at approximately [292249, 201913]. NW of this, a slight resistivity anomaly might mark a NW-directed continuation.

The central part of the survey contains an area of complexly elevated resistivity, terminated towards the NW by an abrupt SW-NE line (dashed line on Figure 14). It is unclear if this line is itself a feature (such as a buried wall-line), or simply a step in the nature or topography of the subsoil. It is possible that this lineation, the slight resistivity anomaly to the N and the buried wall to the E define the boundaries of a small enclosure, with the anomalies surrounding [292230, 201910] perhaps representing an internal structure. However, all of these anomalies (excluding the eastern wall) are of more diffuse and of lower amplitude than the more certain archaeological features to the east; they may simply present variations in the natural distribution of stone.

To the west of the bounding lineation of this central area are two closely spaced strong resistivity anomalies, each 2.5-3.0m EW and 4.0-4.5m NS. These localised features are interpreted as buried cairns, perhaps similar to the feature mapped at [2922201, 201875]. Their small size may suggest that these are clearance cairns. Apart from these probable cairns, the western end of the area is geophysically-quiet, except for evidence from both magnetic and resistivity datasets for the progressive burial of the stony surface by peat towards the SW corner of the surveyed area.

Conclusion

The survey has provided evidence that further features of archaeological interest may be detectable by geophysical means in the area of the known, exposed 'settlements'.

Interpretation of many of the features observed by the geophysical survey is extremely tentative. The existence of further structures immediately to the west of 'Settlement II' seems reasonably certain. The 'quiet' nature of the area to the east of 'Settlement I' suggests this may have been used for agricultural purposes, perhaps when the features interpreted as cairns were constructed. Although it seems plausible this activity was contemporary with the 'Settlements', this was not necessarily so.

The central part of the survey is more complex and might include a further example of an enclosure as seen in the settlements on either side, but this interpretation is very tentative. If the anomalies do represent further structures, then they may not be as well preserved as those to the west and east. Intrusive investigation of these anomalies would be required to determine whether they are indeed associated with archaeological features or of entirely natural origin.

The eastern part of the survey provides tentative evidence that features may have been cut by construction of the post-medieval 'Parish Road', providing some possible relative dating..

Figure Captions

Figure 1: location of the survey area, showing the surveyed controls. STN1 was a temporary base-station located at 292252.772, 201925.181, 464.816; STN5 is the OS benchmark located on top of a boulder next to the path at 292225.403, 201998.828, 469.641 (formerly appearing on OS maps as benchmark with height 1547.6 ft (471.71m)); other survey markers are the temporary grid markers.
OS Mastermap base mapping © Crown Copyright Ordnance Survey 2015.

Figure 2: detail of the survey area, showing in outline the area from which geophysical data were collected, together with the surveyed topographic contours and the outline of the adjacent drystone structures.
OS Mastermap base mapping © Crown Copyright Ordnance Survey 2015.

Figure 3: detail of the survey area, showing in outline the area from which geophysical data were collected, together with the surveyed topographic contours and the outline of the adjacent drystone structures (as Figure 2), also with surveyed breaks-of-slope (in red, 'v' marks steeper side) and surveyed location of larger stones.
OS Mastermap base mapping © Crown Copyright Ordnance Survey 2015.

Figure 4: Ground Resistivity Survey: 0.5m probe spacing; bitmapped images from Geoplot:
a. raw data, uncorrected, greyscale 900Ω measured resistance (black) to 1600 Ω (white).
b. balanced data, greyscale 900Ω measured resistance (black) to 1600 Ω (white).
c. despiked balanced data, greyscale 900Ω measured resistance (black) to 1600 Ω (white).
d. data as (c) high-pass filtered, greyscale -150Ω (black) to +150 Ω (white).
N to right, survey blocks 120m x 20m

Figure 5: Ground Resistivity Survey: 1.0m probe spacing; bitmapped images from Geoplot:
a. raw data, uncorrected, greyscale 900Ω measured resistance (black) to 1500 Ω (white).
b. balanced data, greyscale 700Ω measured resistance (black) to 1400 Ω (white).
c. despiked balanced data, greyscale 700Ω measured resistance (black) to 1500 Ω (white).
d. data as (c) high-pass filtered, greyscale -150Ω (black) to +150 Ω (white).
N to right, survey blocks 120m x 20m

Figure 6: Magnetic Gradiometer Survey: bitmapped images from Terrasurveyor
a. raw data, uncorrected, greyscale -4nT (black) to +4nT (white).
b. destriped data, greyscale -4nT (black) to +4nT (white).

Figure 7: Ground Resistivity Survey: 0.5m probe spacing; interpolated image from Surfer of despiked balanced data, greyscale 800Ω measured resistance (black) to 1500 Ω (white). Black linework shows drystone structures.
OS Mastermap base mapping © Crown Copyright Ordnance Survey 2015.

Figure 8: Ground Resistivity Survey: 0.5m probe spacing; interpolated image from Surfer of despiked balanced data, colour scale as shown. Black linework shows surveyed stones and drystone structures.
OS Mastermap base mapping © Crown Copyright Ordnance Survey 2015.

Figure 9: Ground Resistivity Survey: 0.5m probe spacing; interpolated image from Surfer of high-pass filtered despiked balanced data, colour scale as shown. Black linework shows surveyed stones and drystone structures.
OS Mastermap base mapping © Crown Copyright Ordnance Survey 2015.

Figure 10: Ground Resistivity Survey: 1.0m probe spacing; interpolated image from Surfer of despiked balanced data, greyscale 800Ω measured resistance (black) to 1400 Ω (white). Black linework shows drystone structures.
OS Mastermap base mapping © Crown Copyright Ordnance Survey 2015.

Figure 11: Ground Resistivity Survey: 1.0m probe spacing; interpolated image from Surfer of despiked balanced data, colour scale as shown. Black linework shows surveyed stones and drystone structures.
OS Mastermap base mapping © Crown Copyright Ordnance Survey 2015.

Figure 12: Ground Resistivity Survey: 1.0m probe spacing; interpolated image from Surfer of high-pass filtered despiked balanced data, colour scale as shown. Black linework shows surveyed stones and drystone structures.
OS Mastermap base mapping © Crown Copyright Ordnance Survey 2015.

Figure 13: Magnetic Gradiometer Survey: interpolated images from Surfer, greyscale -4nT (black) to +4nT (white). Black linework shows drystone structures.
OS Mastermap base mapping © Crown Copyright Ordnance Survey 2015.

Figure 14: summary interpretation. Dark grey – mapped drystone structures; brown – drystone structures intepreted from geophysics; light brown – positive resistivity anomalies possibly indicative of buried stone accumulations; black line – boundary of probable peat accumulation; dashed black linear – the abrupt NW boundary of central stony area; black closed areas show surveyed stones; red lines are the strongest of a set of magnetic lineations and correspond in location to a track or boundary visible on aerial photographs. For further details see text.
OS Mastermap base mapping © Crown Copyright Ordnance Survey 2015.

Figure 1

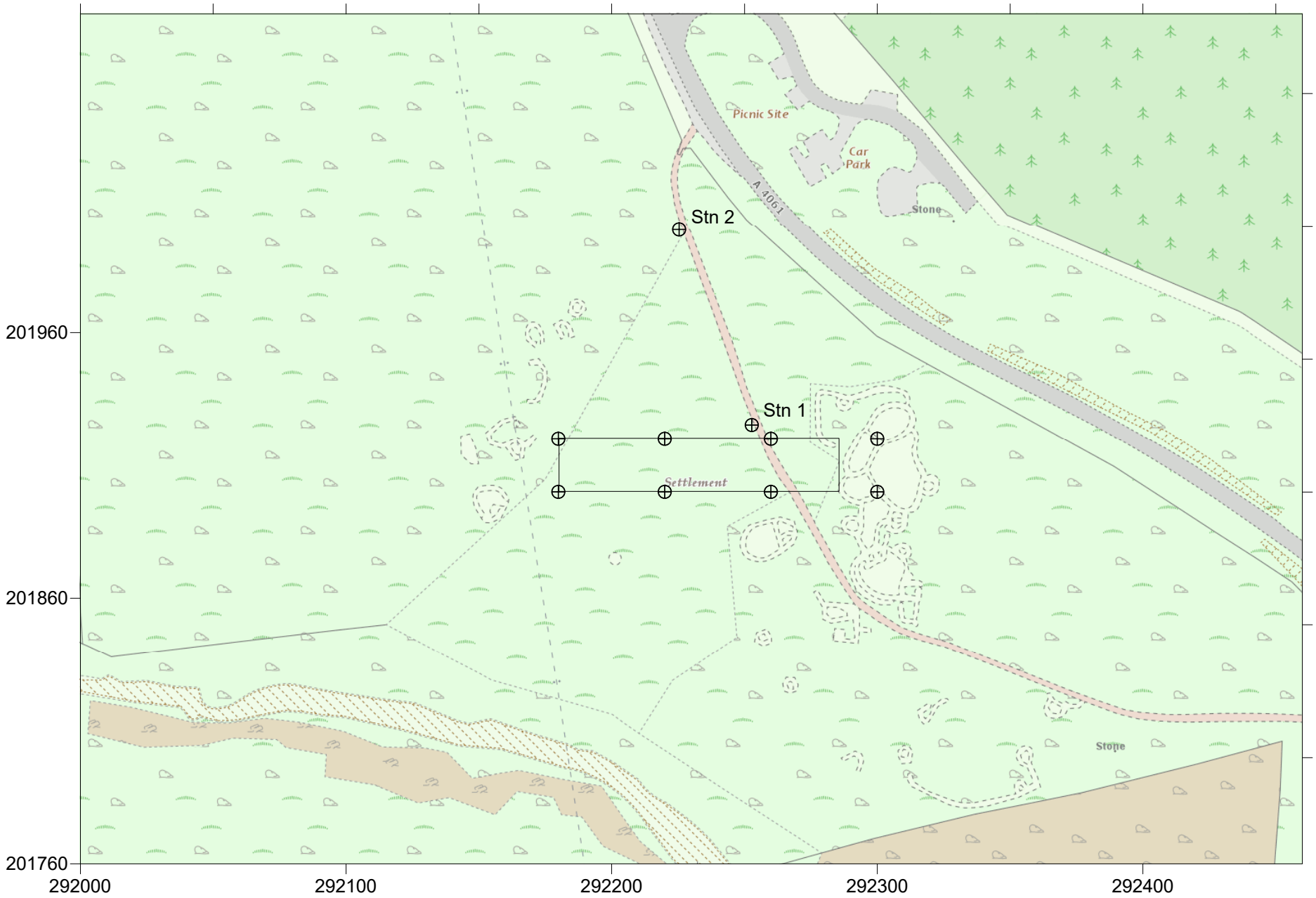
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Figure 2

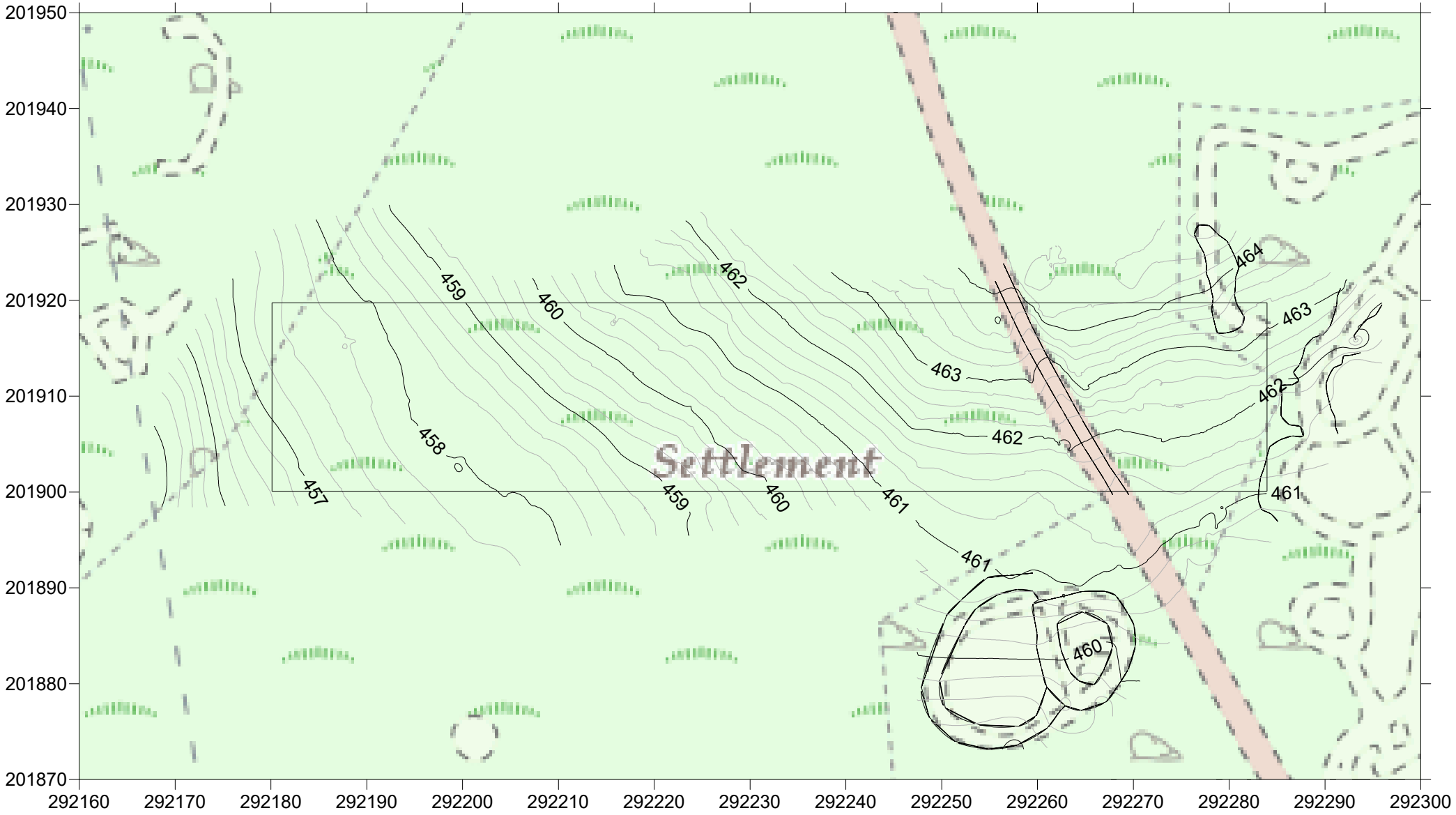
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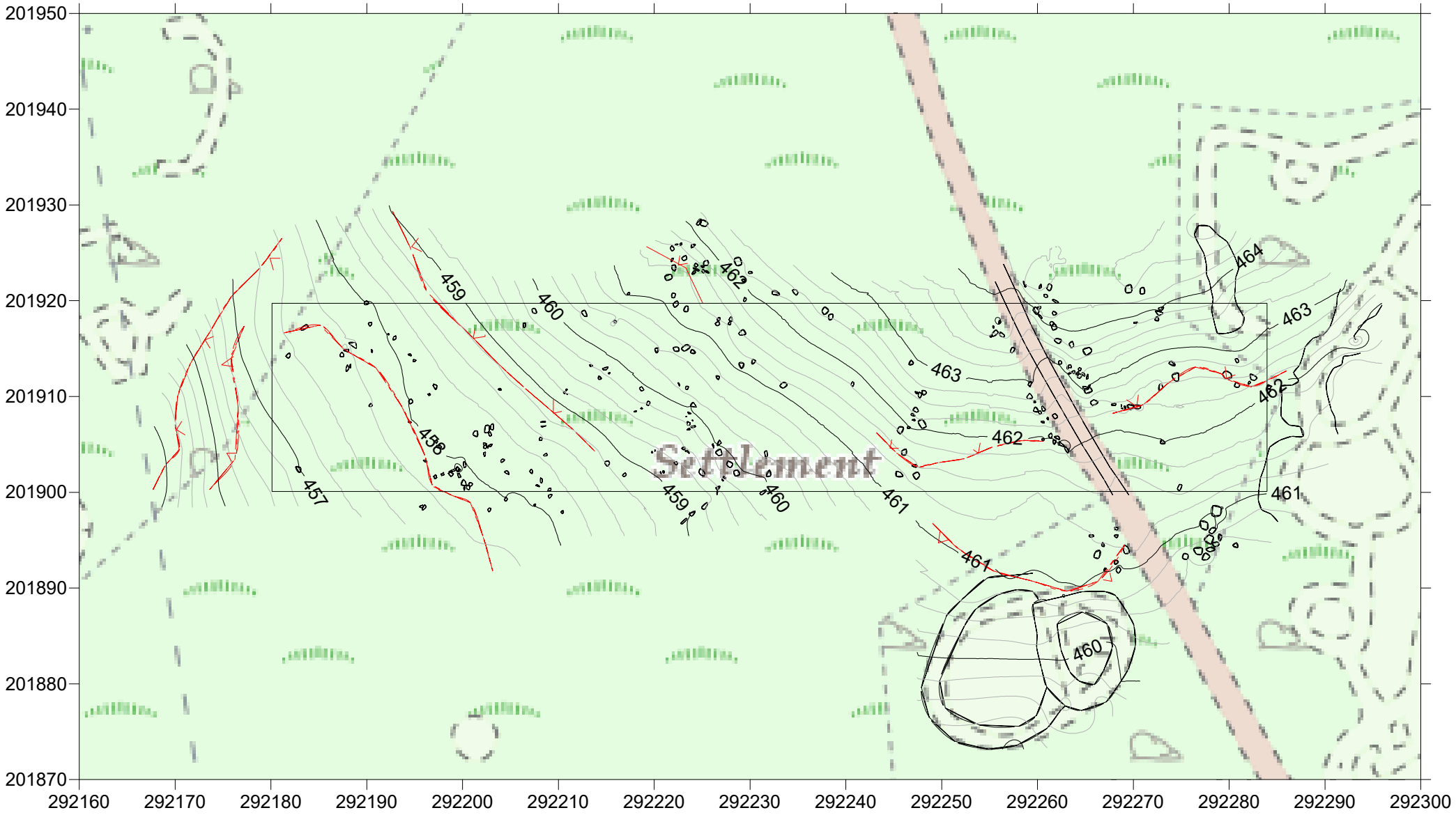
Figure 3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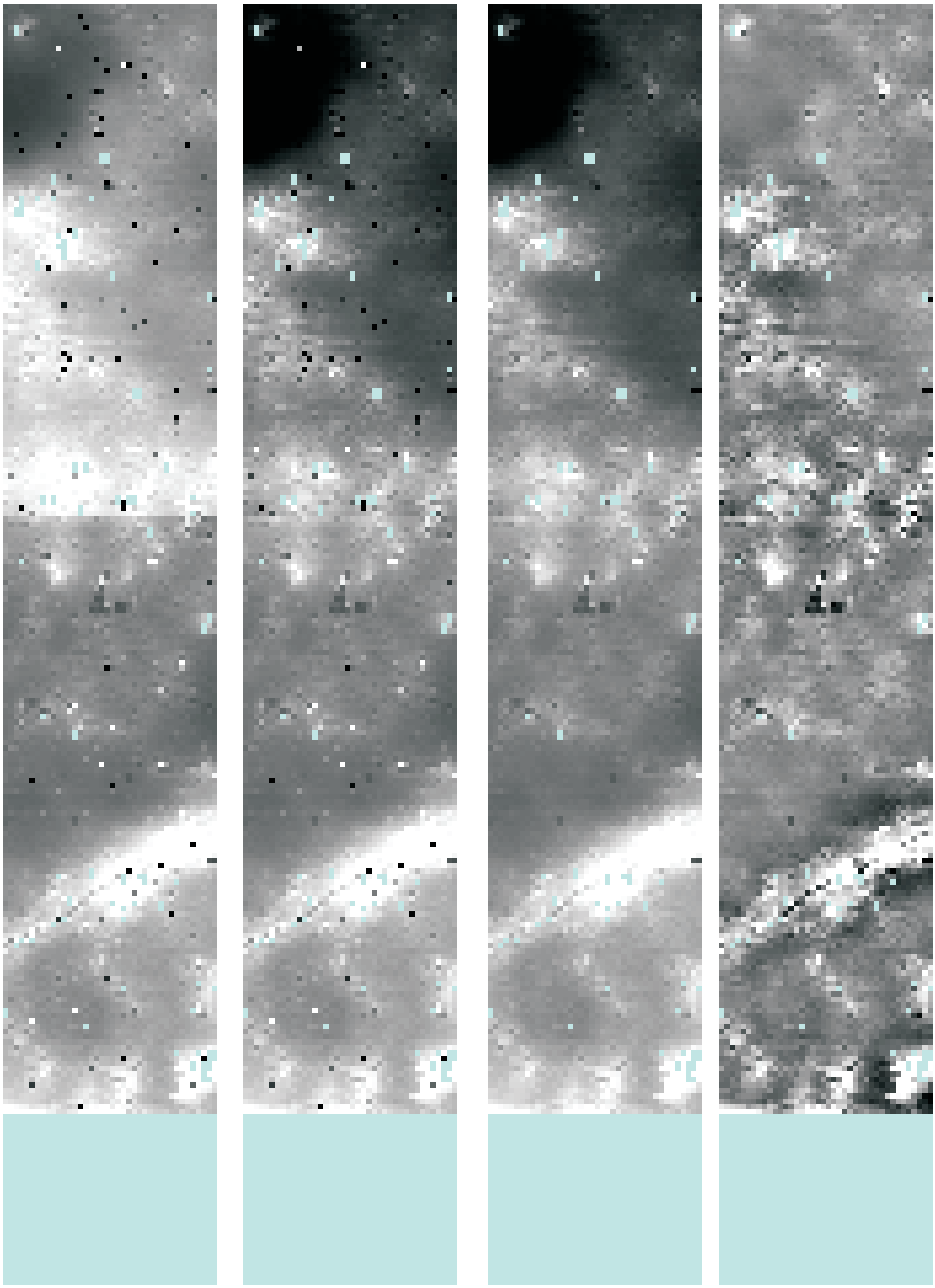
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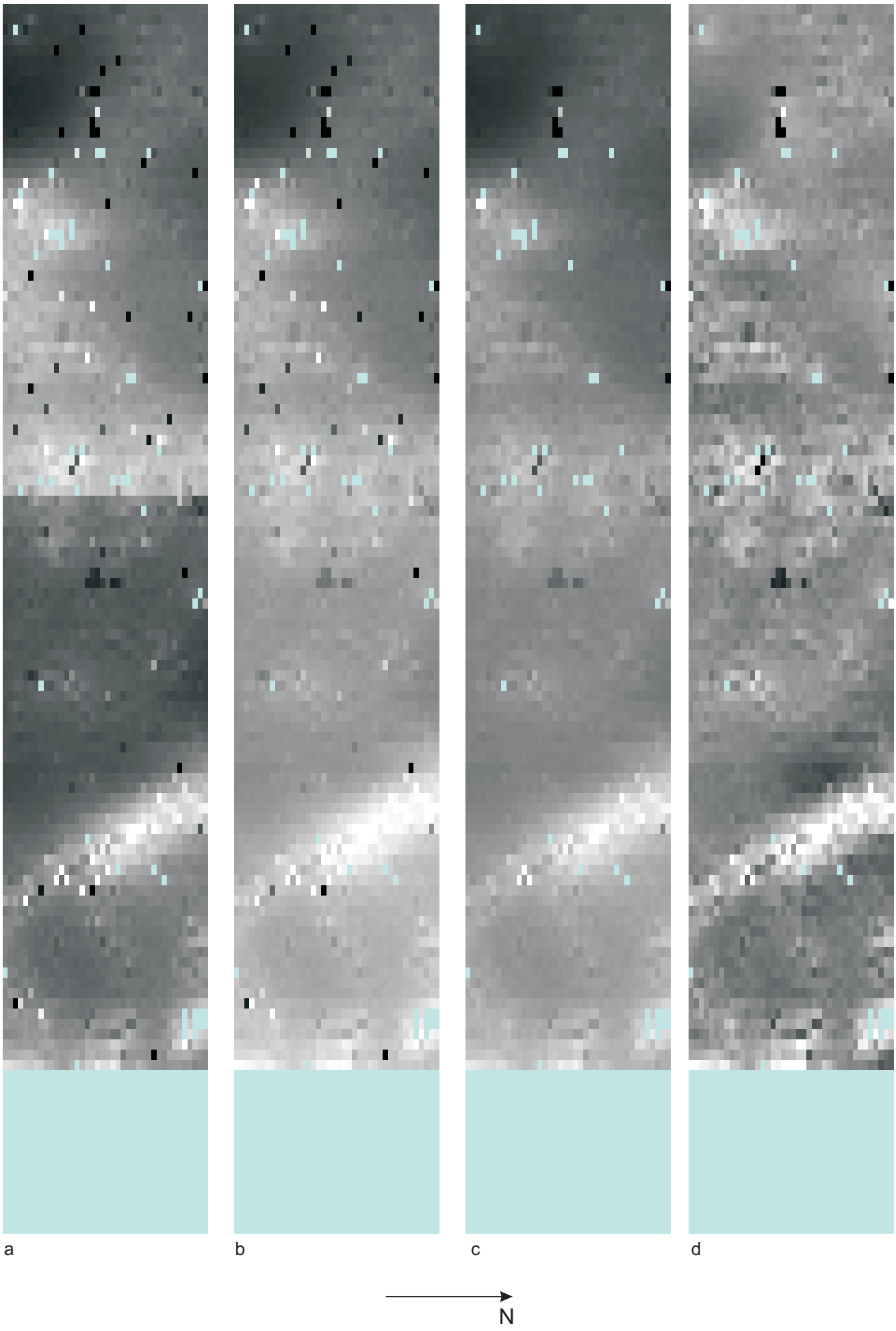
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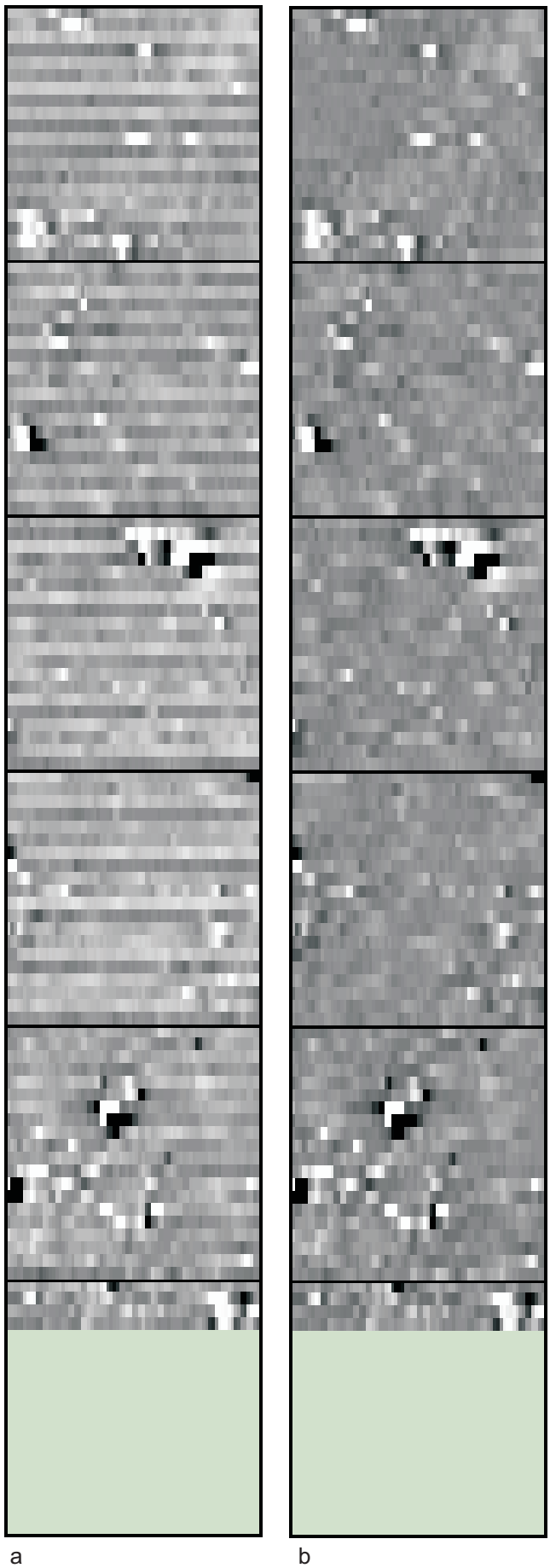
Figure 6



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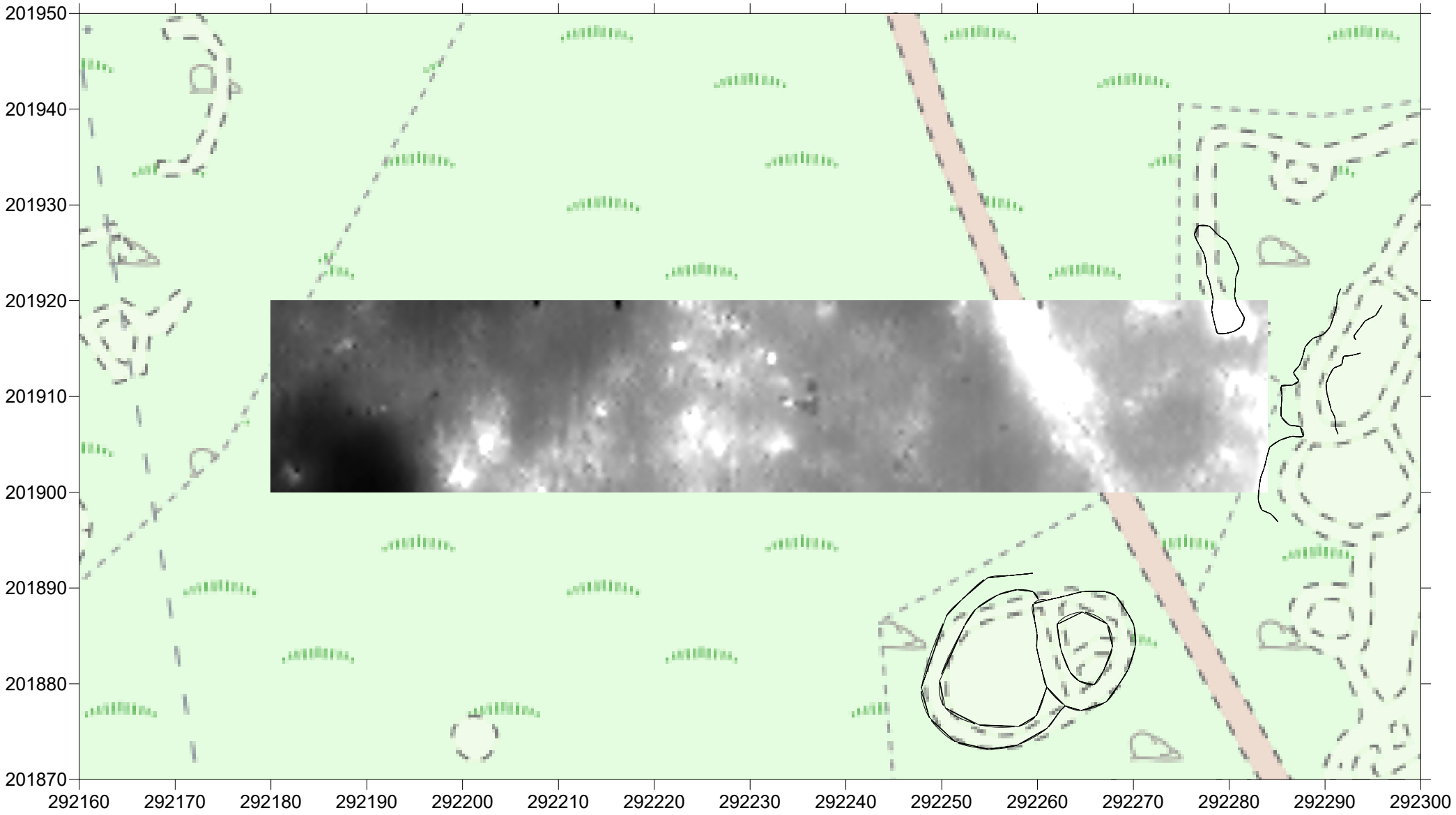
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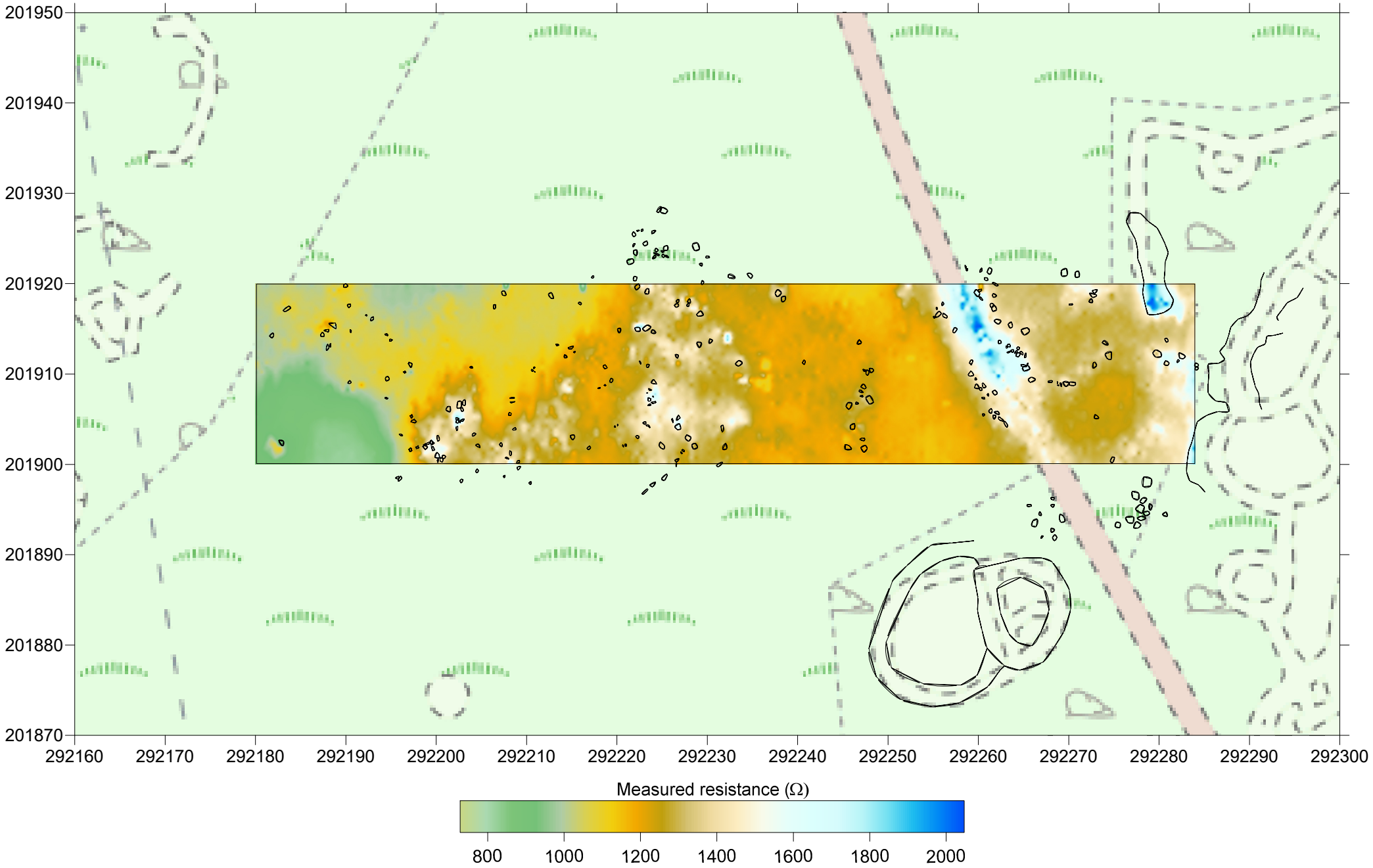
Figure 8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Measured resistance (Ω)
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Figure 9

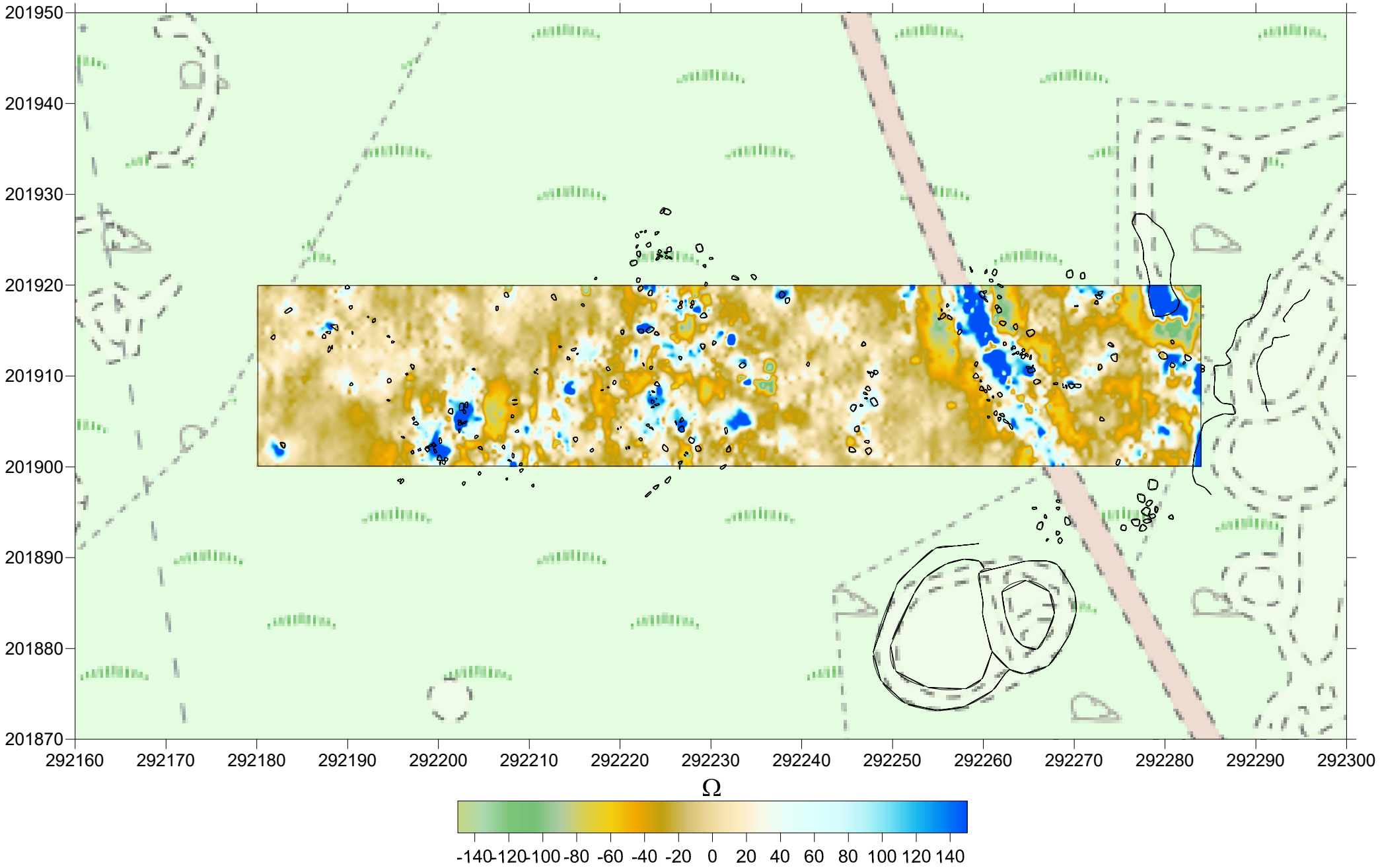
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Figure 10

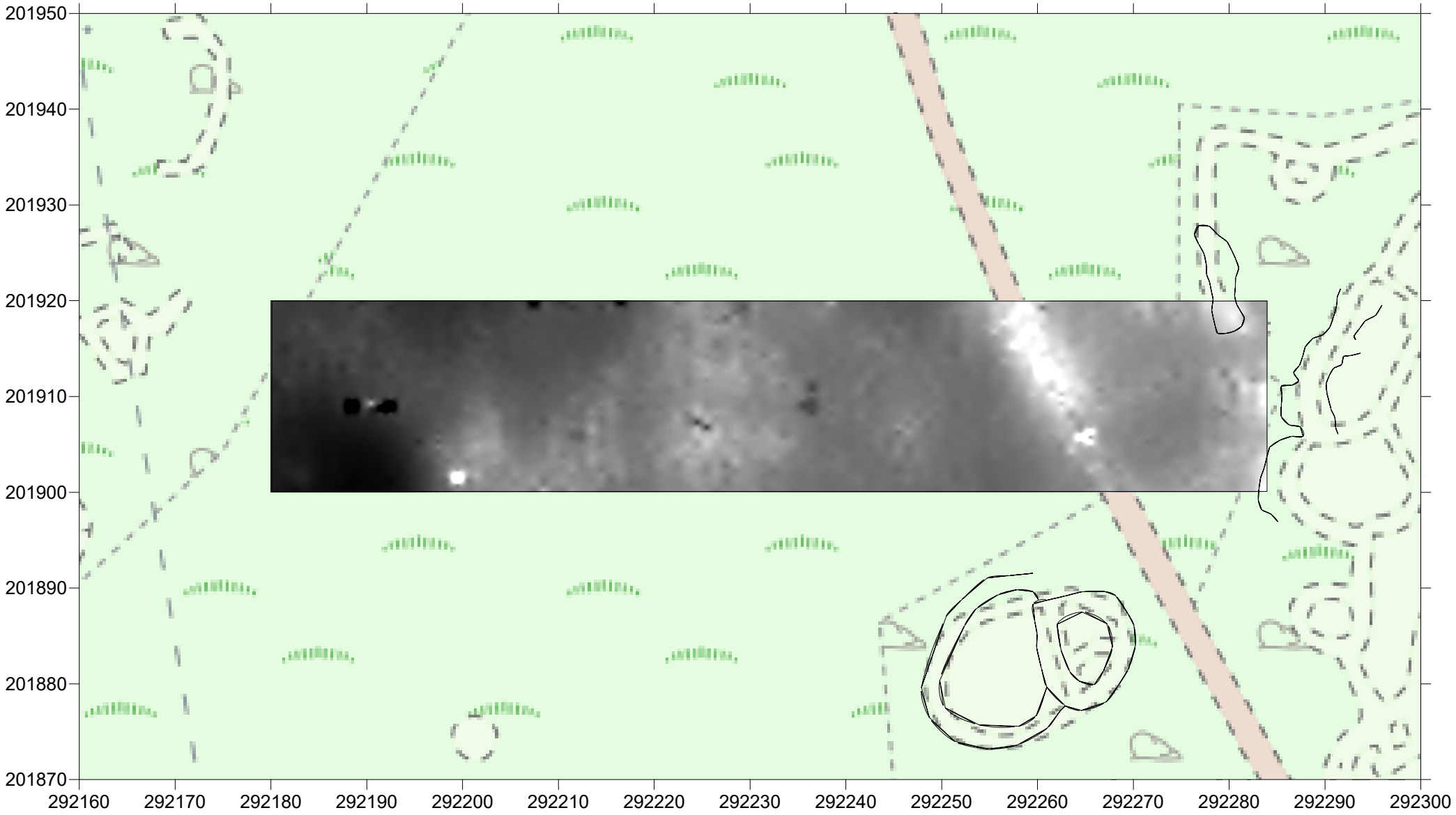
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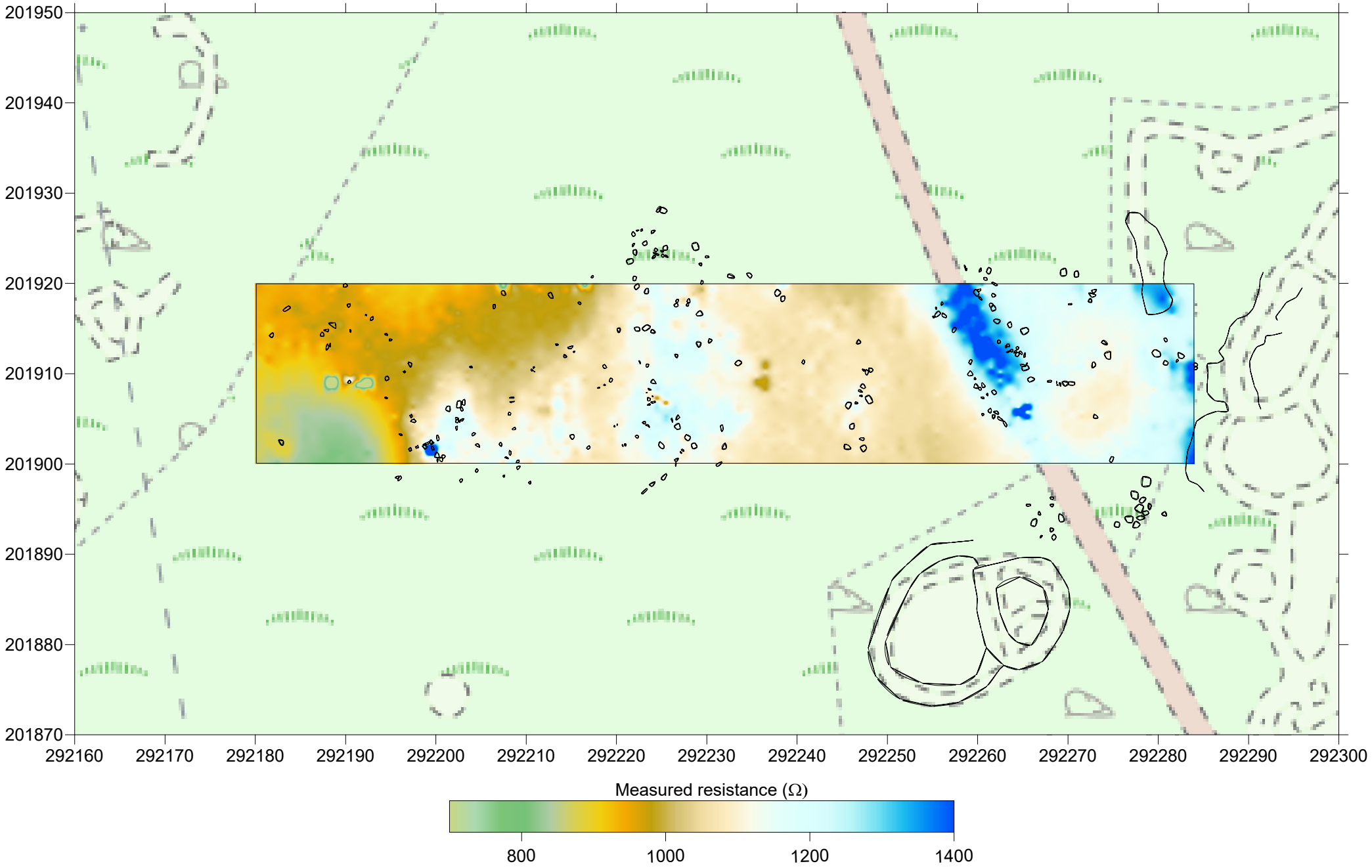
Figure 11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Measured resistance (Ω)
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Figure 12

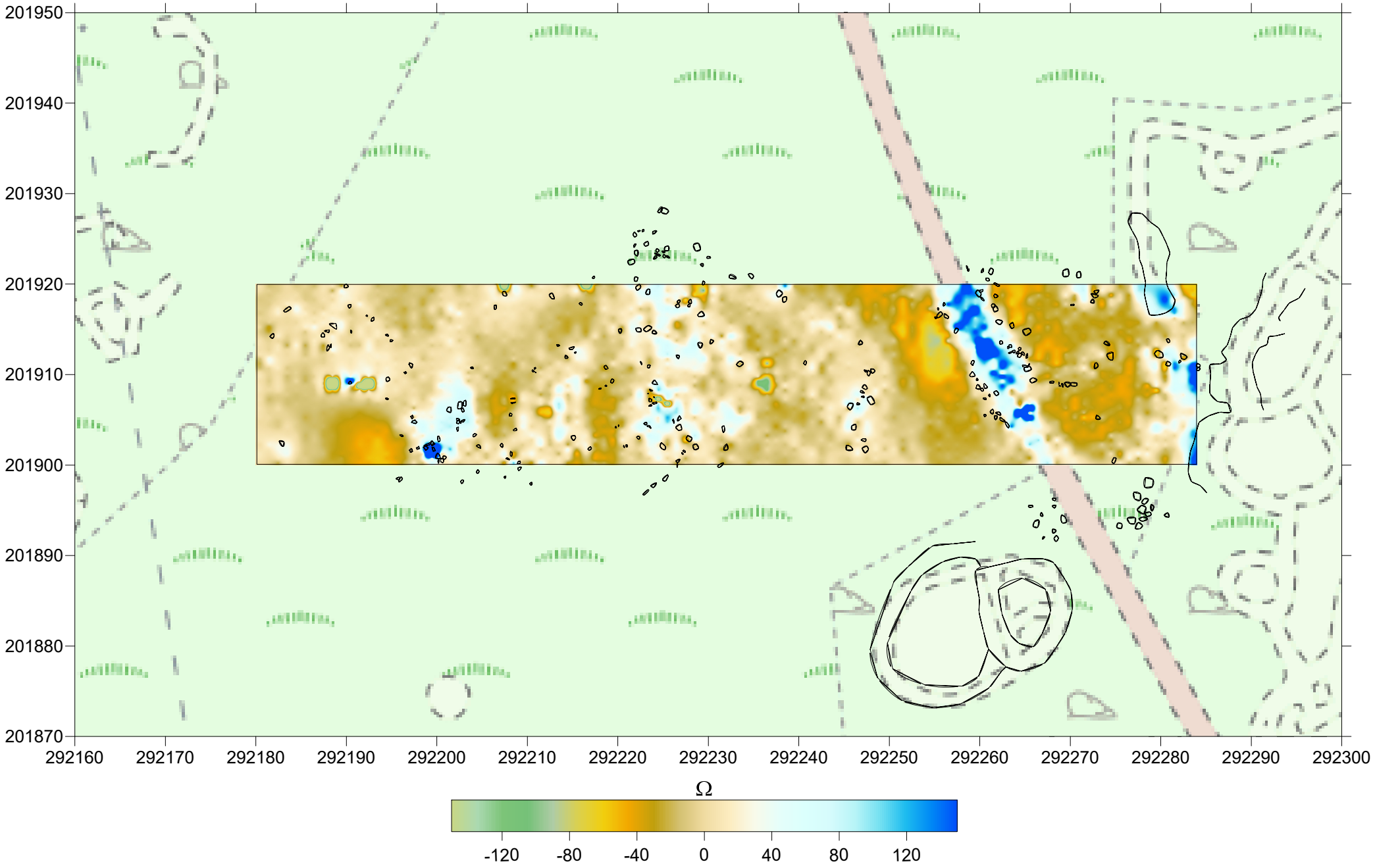
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Figure 13

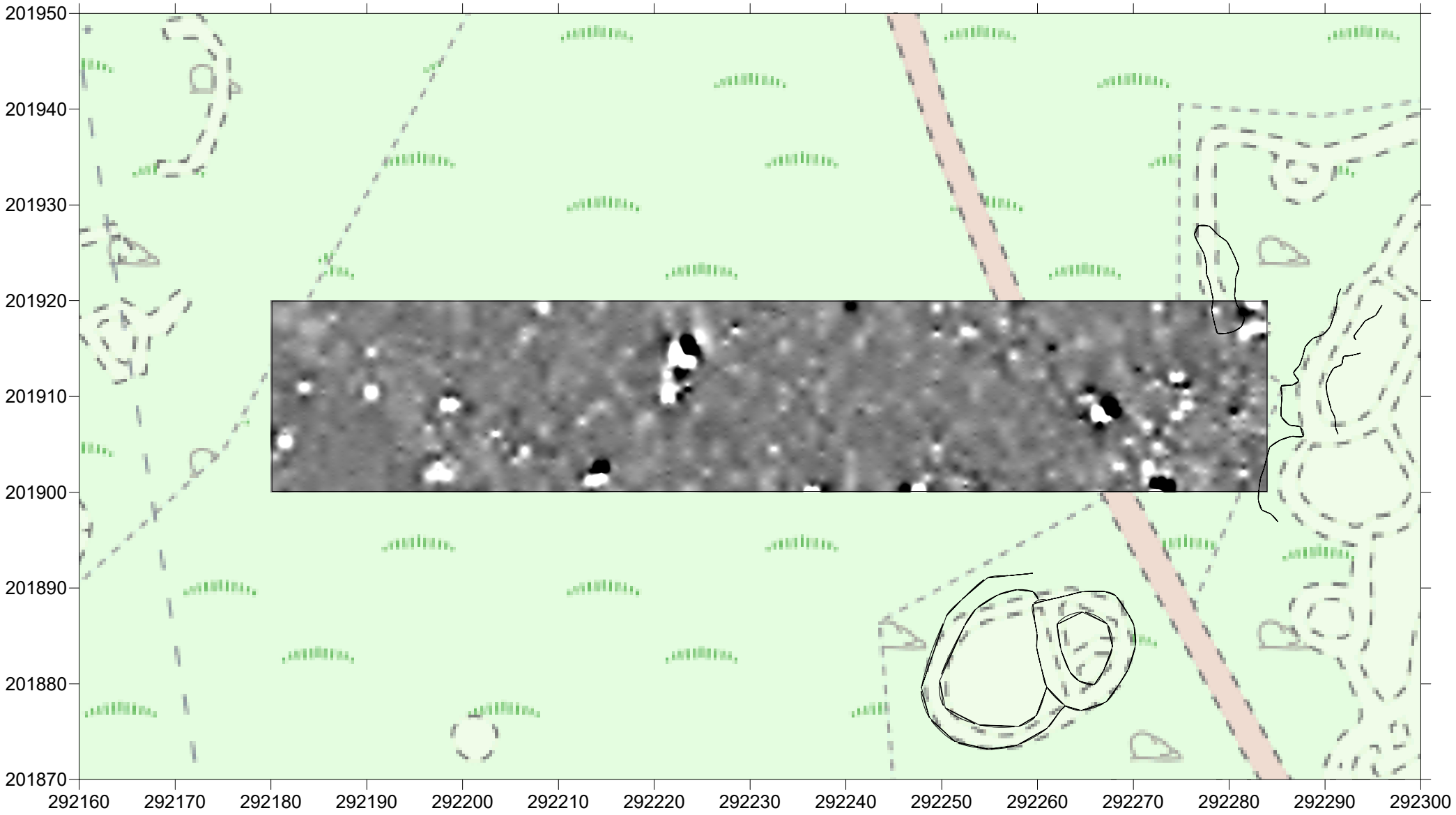
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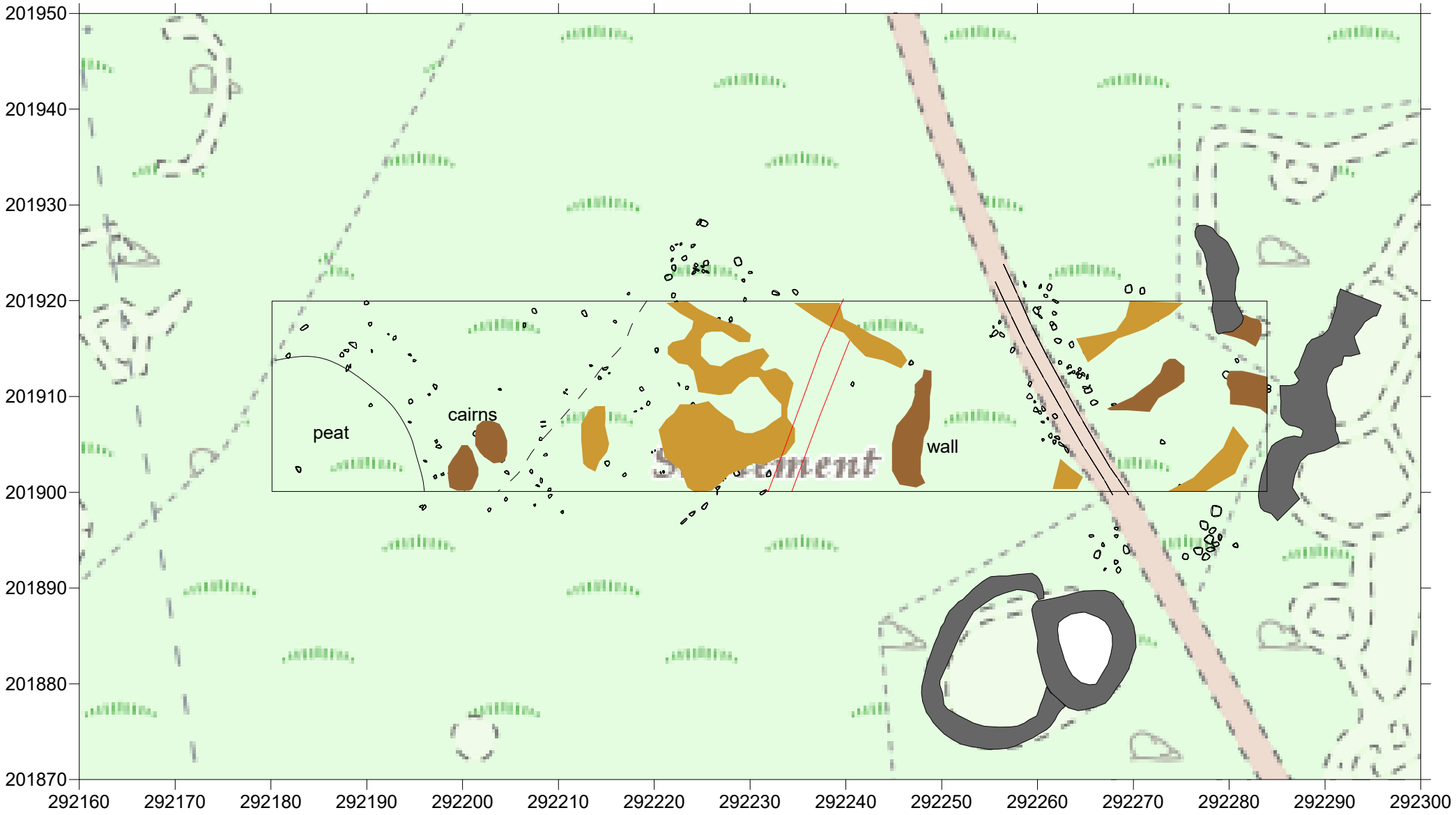
Figure 14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