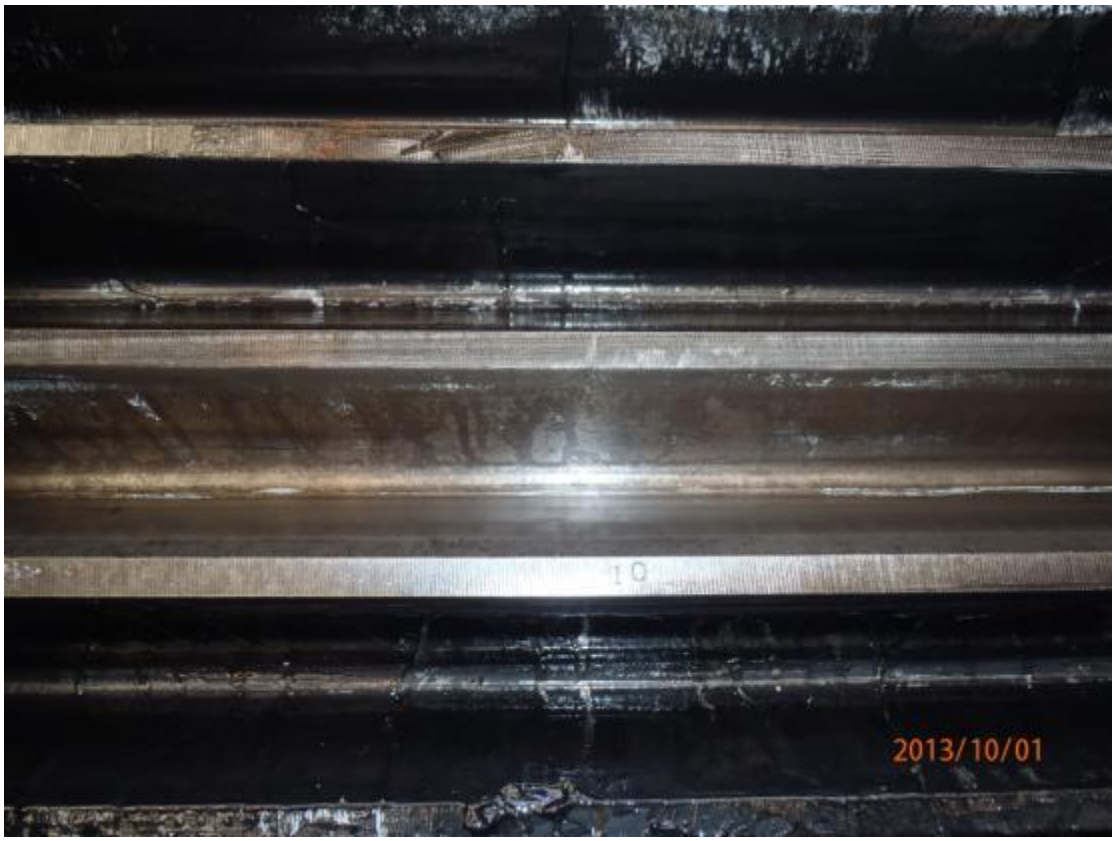
Goldmine



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Review and notes	Brendan Wicks	11/10/2013
Client	Goldmine	Gold Company
Repair date	Ball Mill	

TABLE OF CONTENTS

1 Scope:

- Complete NDT scan of ball mill girth gear.
- Identification and remediation of localised surface fatigue generated spalling on the ball mill girth gear.
- Reduction of localised load concentrating features by hand linishing
- Reduction of load concentration at the pitch circle by protruding pitch line on girth gear and pinion by hand linishing

2 Background:

During a routine NDT inspection of the ball mill girth gear in August 2013; a number of stress concentrating features were noted on the girth gear teeth. A comparison was made with the results of the inspection carried out in 2011 and presented to Goldmine. It was decided that for the medium to long term well being of the gear that the gear should have the load and stress concentrating features remediated at an appropriate time. An extended outage primarily for the change of the SAG motor was programmed for the first 3 weeks of October provided the opportunity to carry out this work.

The NDT inspection during August was not completed due to inching drive reliability problems. As a result from the 1st until the 3rd of October, firstly the NDT scan was completed and then remedial work on the gear surfaces carried out.

3 Results

Of the 312 teeth on this gear a 198 teeth were scanned in August. The remaining teeth from tooth 1 to 44 and from 243 to 312 were scanned and the results compiled.

Gear teeth that had observable stress concentrators and gear teeth that gave a significant eddy current reading were remediated by excavating, profiling and polishing the areas where either surface fatigue or other stress concentrating features existed.

The process for removing fatigued material or other stress concentrating geometry is included for reference.

The gear flanks and pinion were hand linished to reduce local protruding geometries that cause local load concentrations which in turn can lead to surface fatigue.

The gear teeth that triggered a visual inspection are summarised in the table below. The “Combined channel index” is a number derived from all of the eddy current array channels indicating the disturbance to the eddy current in the gear surface. It is included for comparative purposes.

While this is not a gear condition report some comments are offered in section 4 below.

Summary List of Indications

Table 1

Tooth Number	Combined Channel index	Tooth Number	Combined Channel index
A-003	28.30	A-183	9.12
A-016	13.10	A-186	9.02
A-030	**23.15**	A-187	9.88
A-039	18.31	A-189	9.19
A-040	**34.48**	A-195	9.03
A-050	9.00	A-196	9.28
A-055	9.20	A-207	9.20
A-067	13.55	A-239	**32.91**
A-077	9.63	A-256	15.90
A-125	9.07	A-259	9.35
A-126	10.37	A-260	**19.98**
A-154	9.34	A-279	11.60
A-181	**24.80**	A-286	9.12

Table 2 – Gear teeth excavated and profiled.

Tooth Number	Comment
A-003	Advanced destructive spalling - deterioration apparent since 2011
A-030	Destructive spalling not showing deterioration since 2011
A-040	Previous excavation profile and polish
A-125	Previous excavation profile and polish
A-126	Previous excavation profile and polish
A-181	Significant magnetic anomaly detected - minor surface breaking evidence
A-239	Destructive spalling showing no discernible deterioration since 2011
A-260	Destructive spalling showing some deterioration since 2011

4 Observations:

Comparisons with the 2011 inspection revealed that in most cases there was no discernible change in of the areas that had spalled with a few notable exceptions:

Tooth 003A (load side of tooth number 3) has experienced noticeable deterioration where some localised spalling has expanded and evidence of fatigue over the local region was evident. Tooth 260 A had also deteriorated where additional fatigue spalls had fallen from the gear surface. Both of these gear teeth have been remediated by profiling the fatigued material and polishing the excavated surface to prevent crack re-initiation.

Both the pinion and girth gear had protruding pitch lines. In the case of the pinion the elevated pitch line was removed using a die grinder and 80 grit flap wheel. In the case of the girth gear a 7" pneumatic sander and 36 grit abrasive paper discs. Results of the excavations and linishing can be seen in section 6 Jobsite photos and Scans

5 Discussion

It is understood that the operation at Goldmine is likely to decrease the throughput of the processing plant weight of the ball mill. In any event – the work that has been done will reduce the risk of further deterioration of the gear surface due to surface fatigue spalling.

Reduction of abrasive contaminant ingress, using a heavy duty lubricant and maintaining proper pinion to girth gear alignment will reduce the opportunities for surface fatigue due to localised load concentration.

SITE PHOTOGRAPHS
AND
SCAN
PRINTOUTS

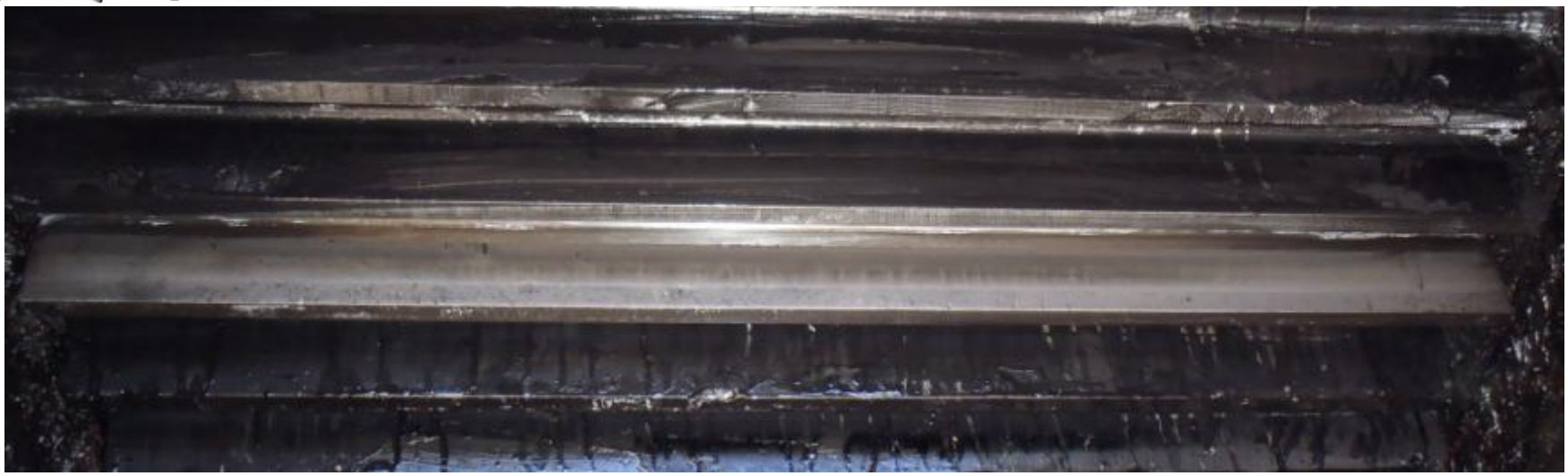
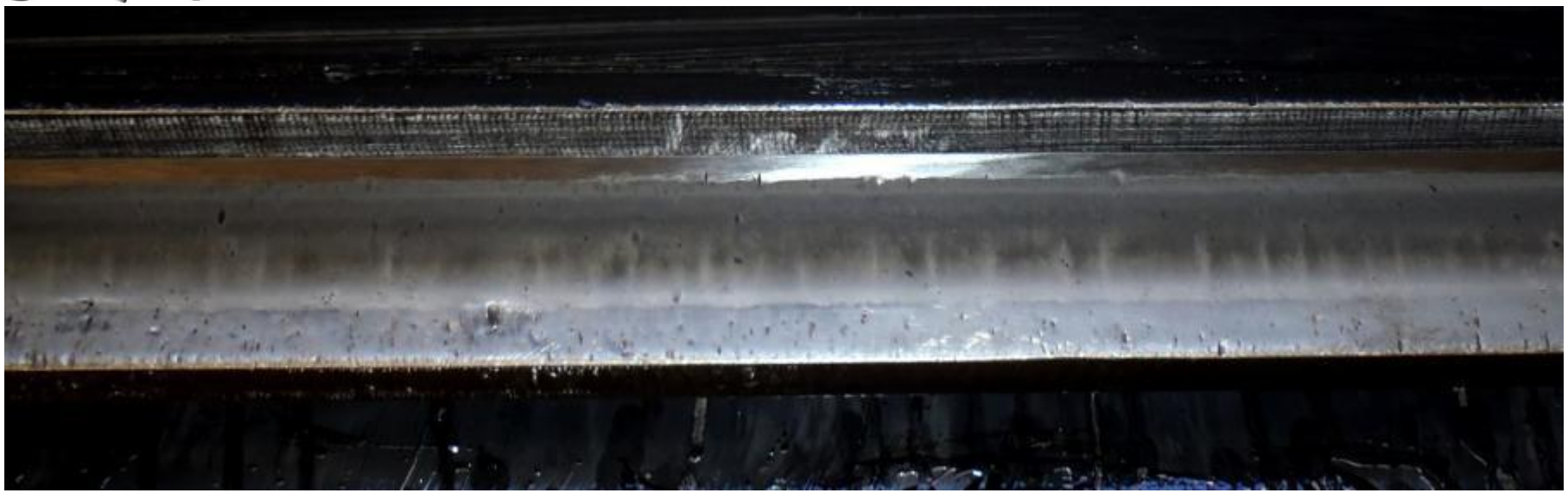


Fig 1 General view of load side tooth 10

Fig 2 General view of pinion

Fig 3 Tooth profile before linishing

Fig 4:Tooth profile after linishing



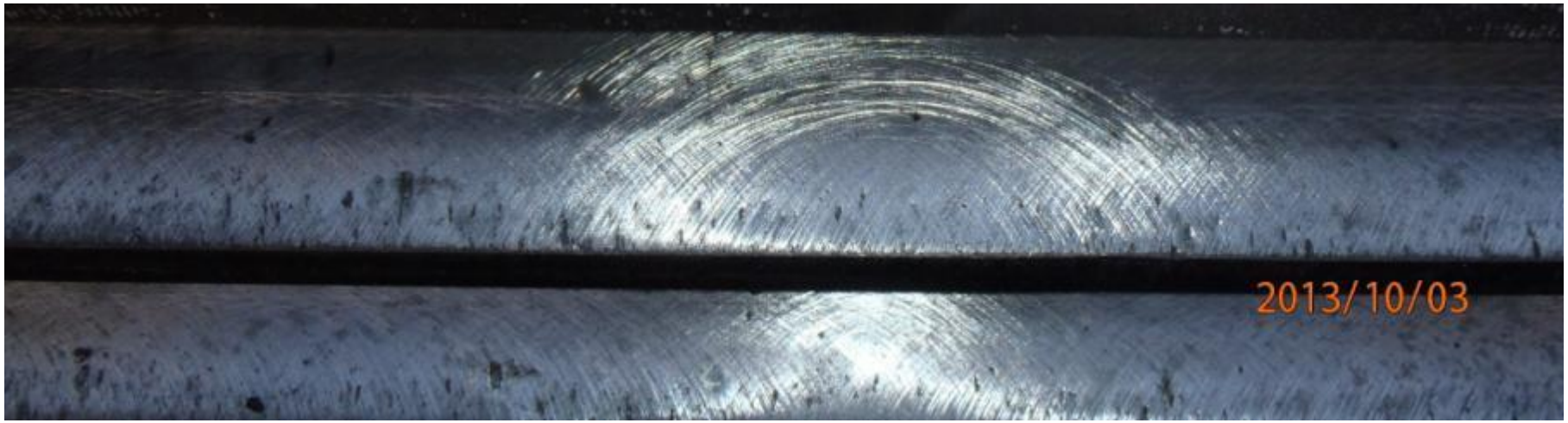


Fig 5(Above): Gear tooth centre before linishing Frig 5B (Below) Gear tooth centre after linishing note the continuous linish marks indicating removal of local protrusions

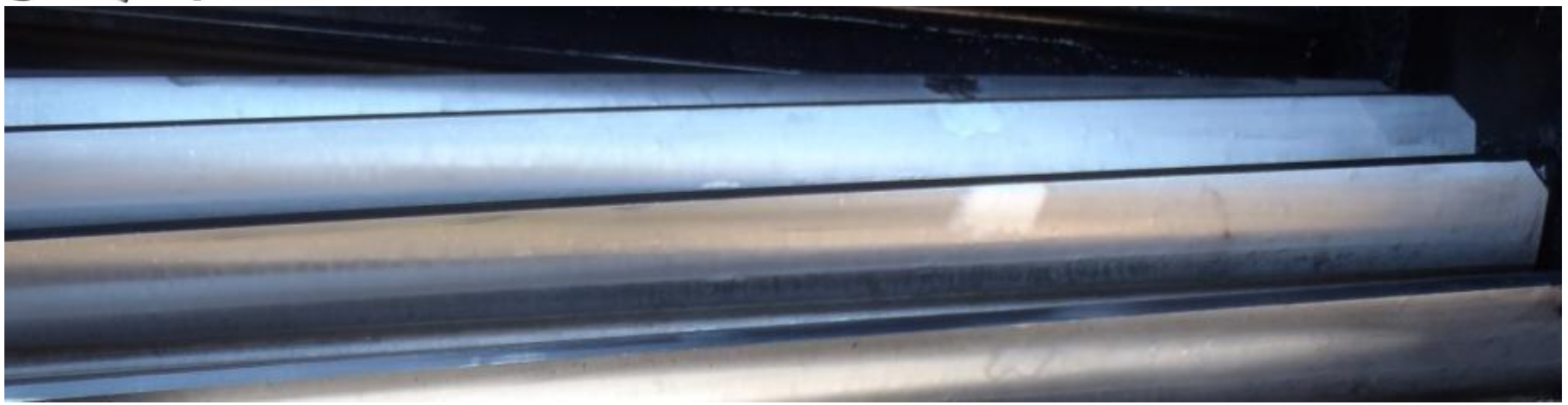


Fig 6a (above) Pinion prior to linishing Fig 6b (below) Pinion after linishing

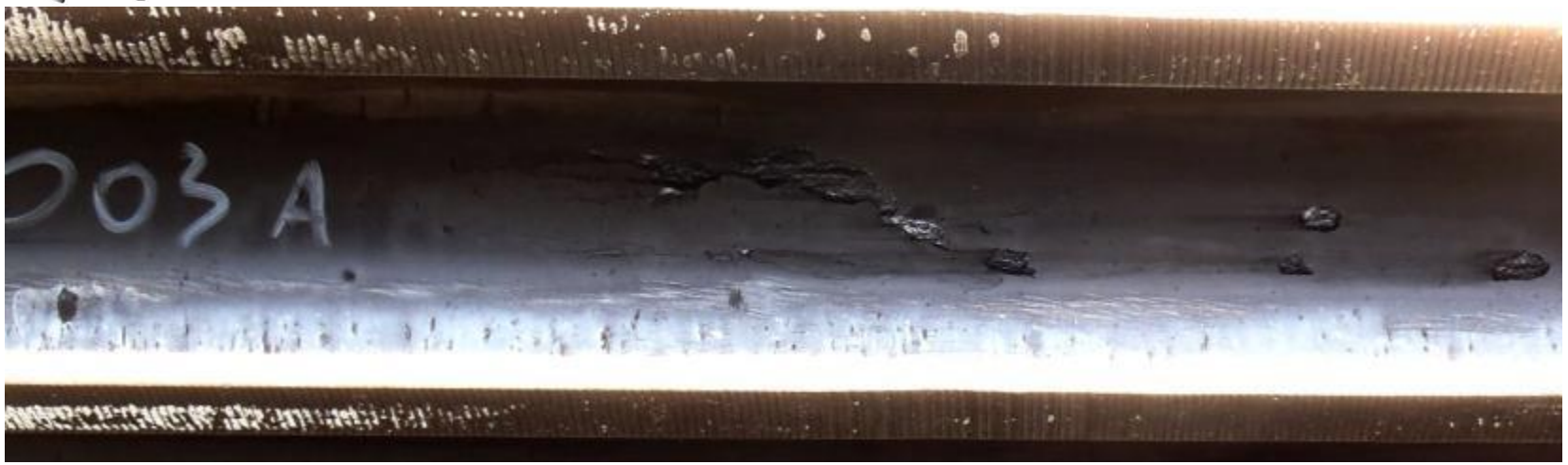


Fig 7 Tooth 003A Oct 3013 surface showing obvious fatigue and exfoliation

Fig 8 Tooth 003A 2011

Fig 9 first stage of excavation – a chunk had cracked under the surface (dark grey area)

Fig 10 Final profile and surface finish of excavation

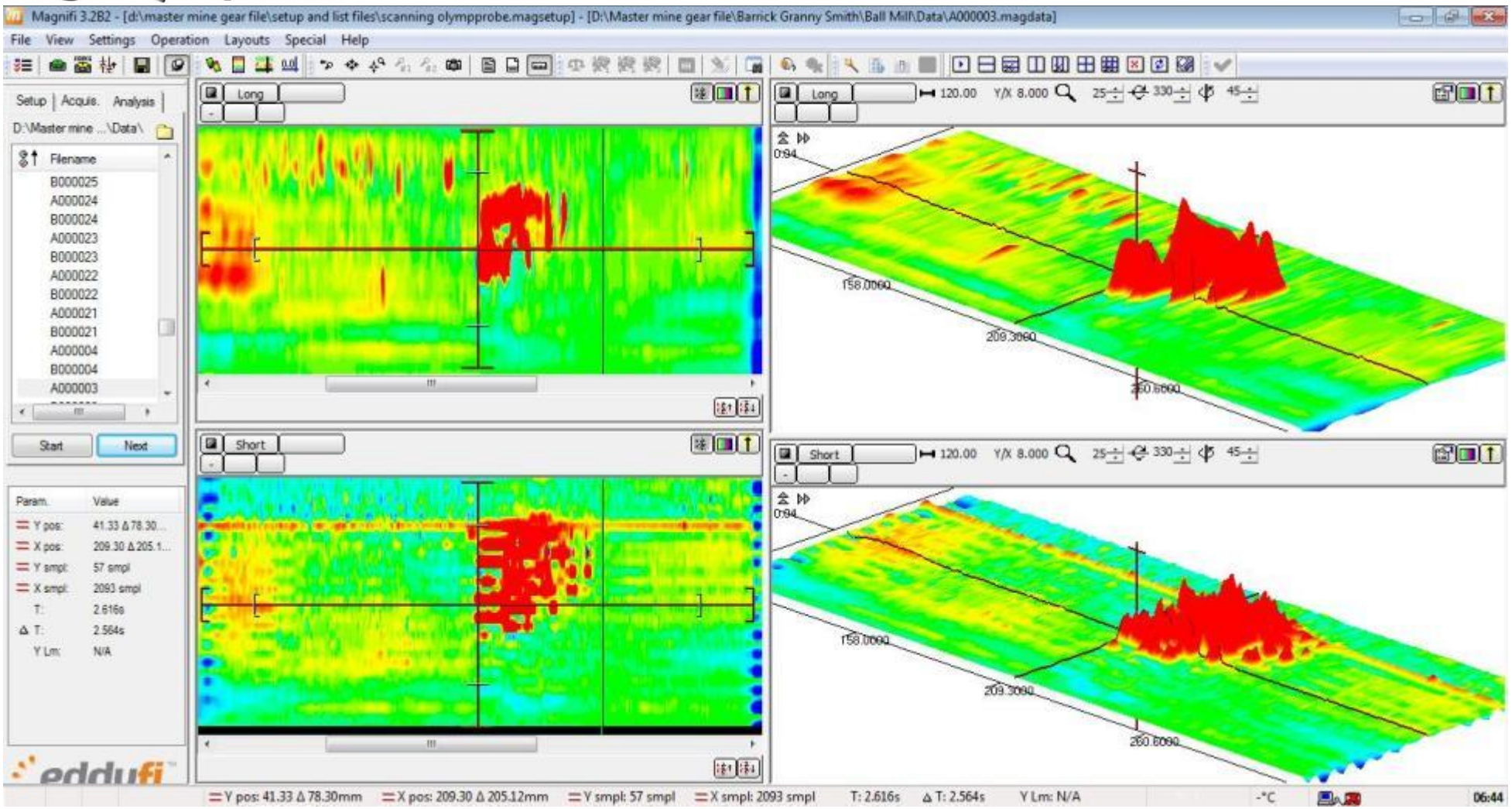


Fig 11 Scan of tooth 003A

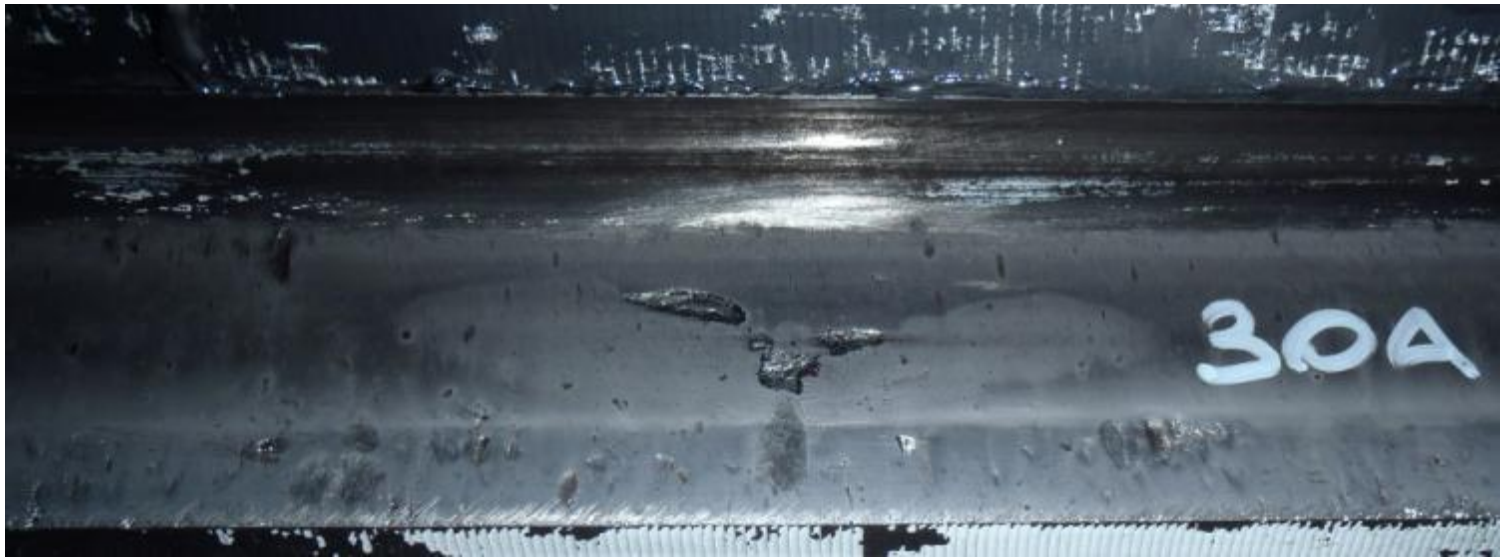


Fig 12 Tooth 030A 2013

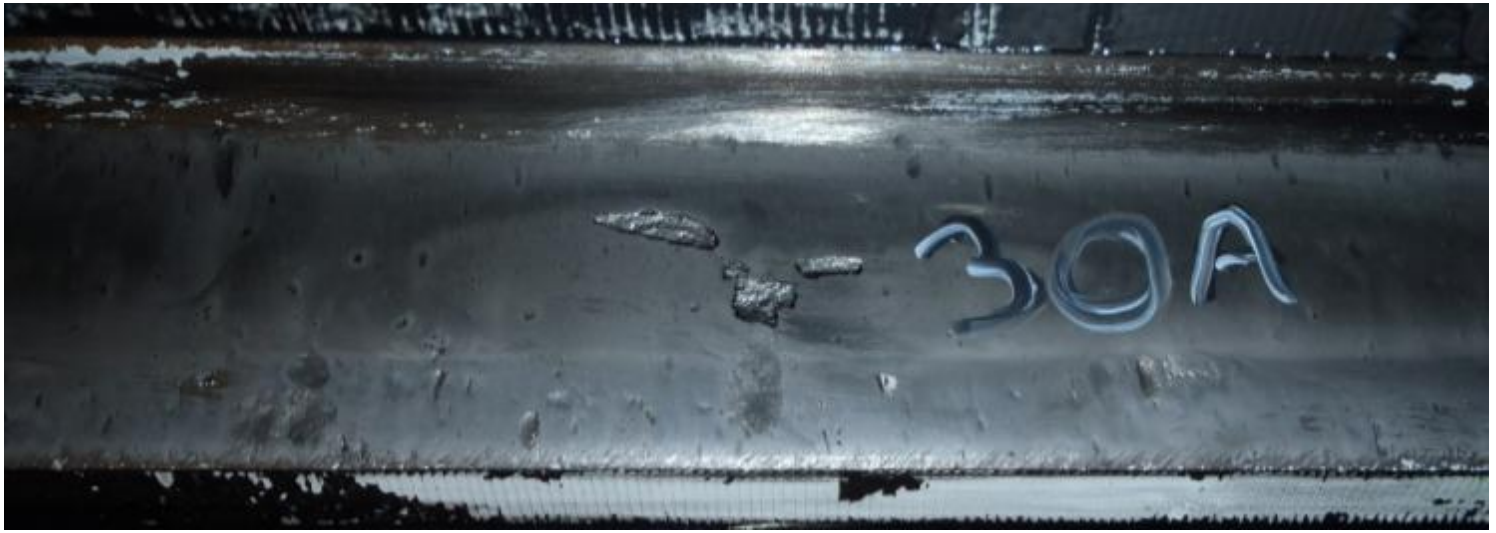


Fig 13 – Tooth 030A No noticeable change since 2011

Fig 14 excavated and profiled tooth 30 A

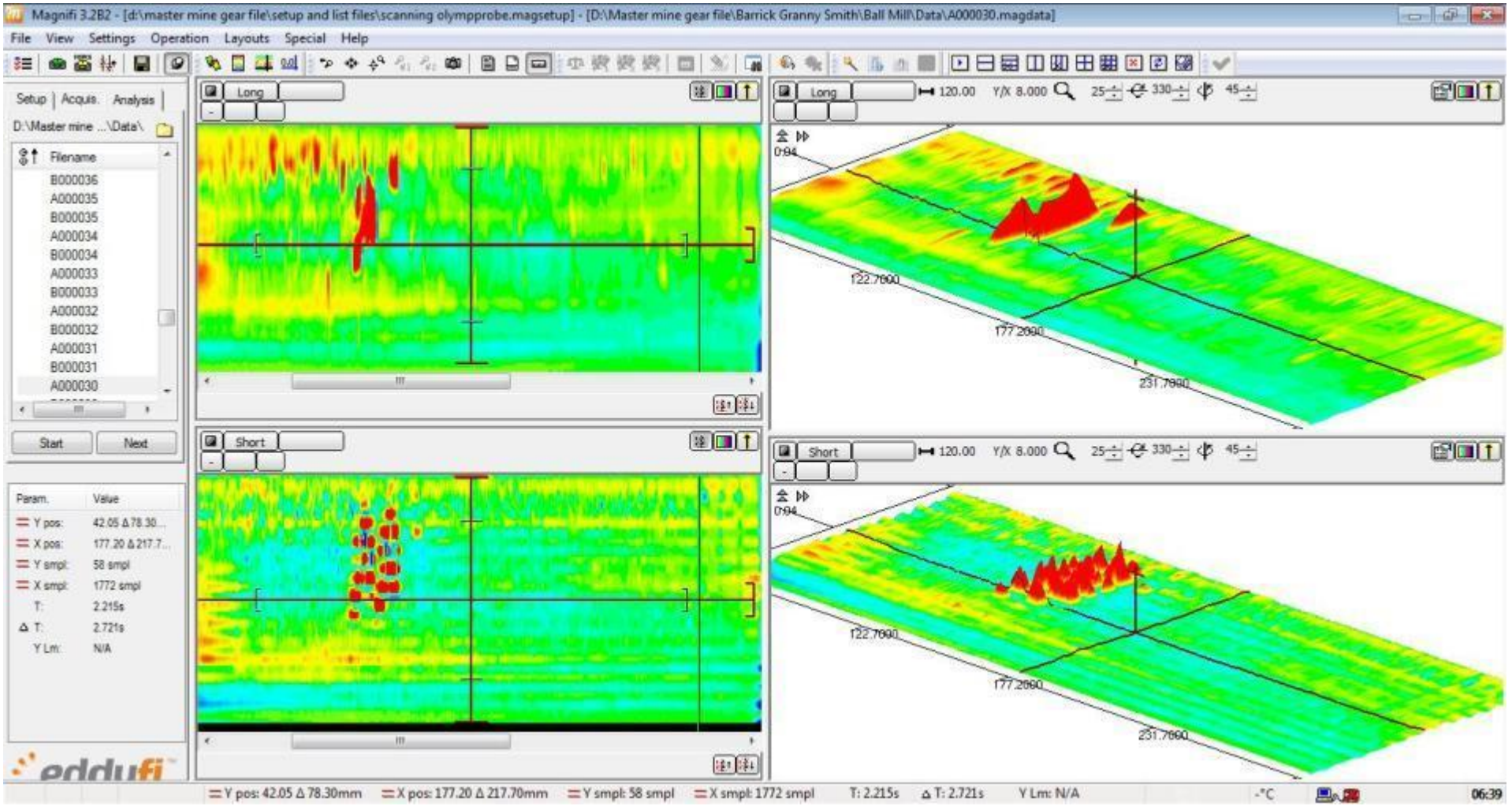


Fig 14 scan of Tooth 030A

Fig 15 Tooth 40A 2013

Fig 16 Tooth 40 2011

Fig 17 Tooth 40 excavation

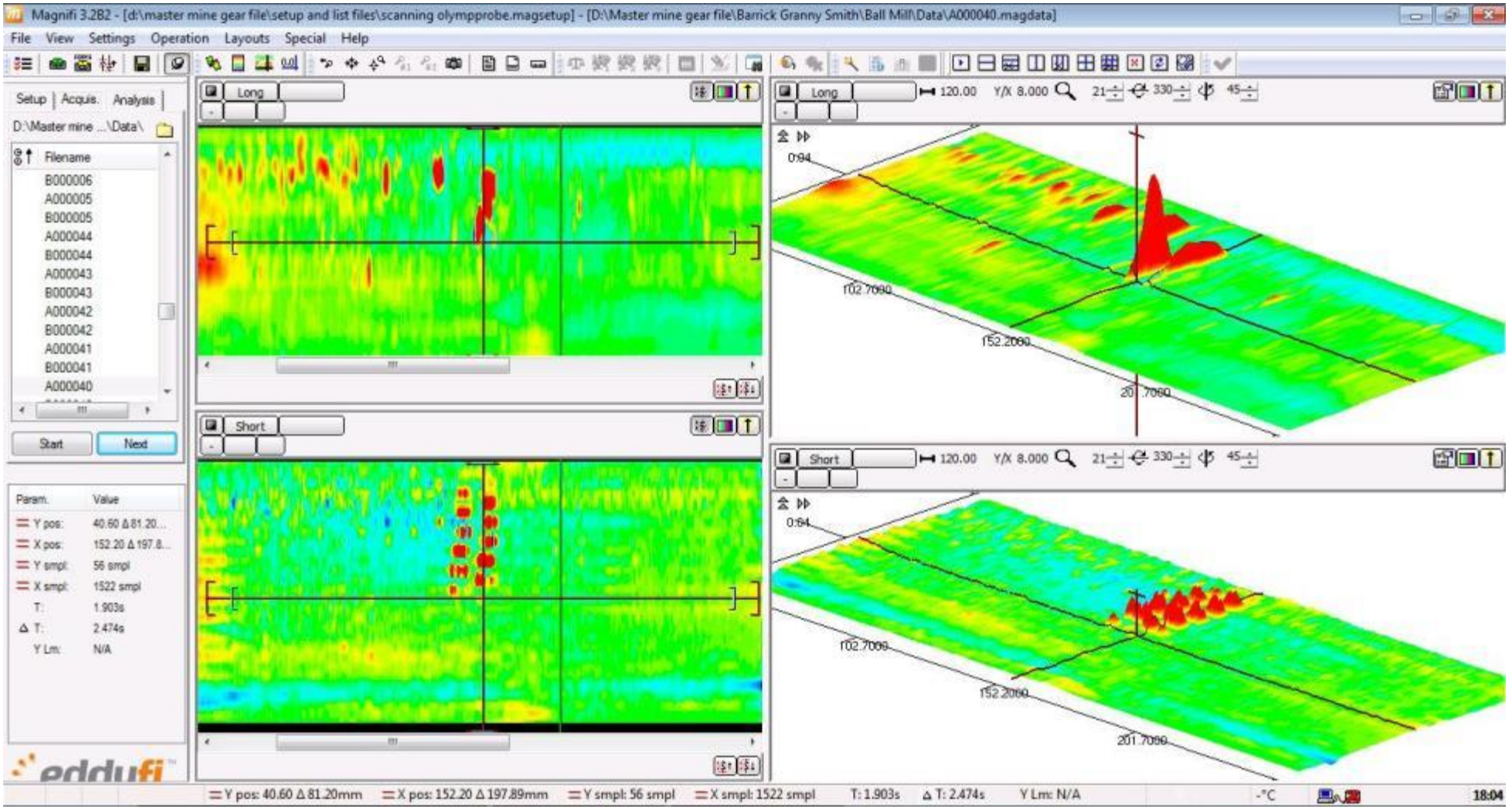


Fig 18 Scan of tooth 040A

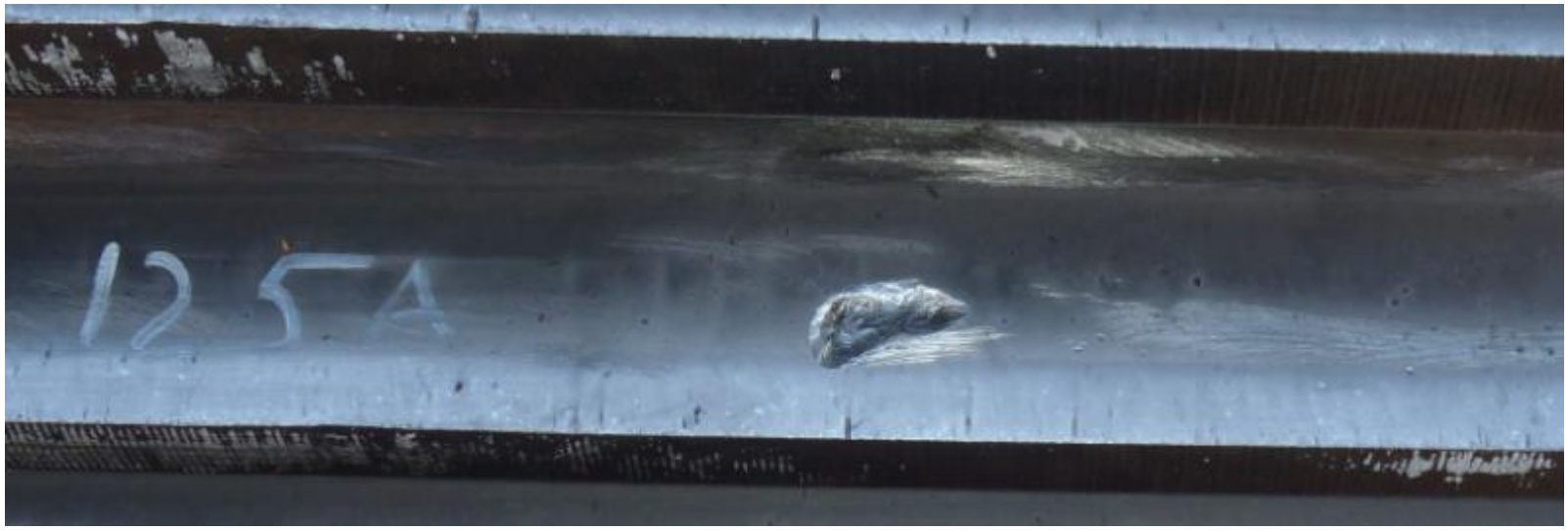


Fig 19 Tooth 125 A

Fig 20 tooth 125 polished

Fig 21 A and b Tooth 126A before and after

Fig 22a and b Tooth 181 A before and after

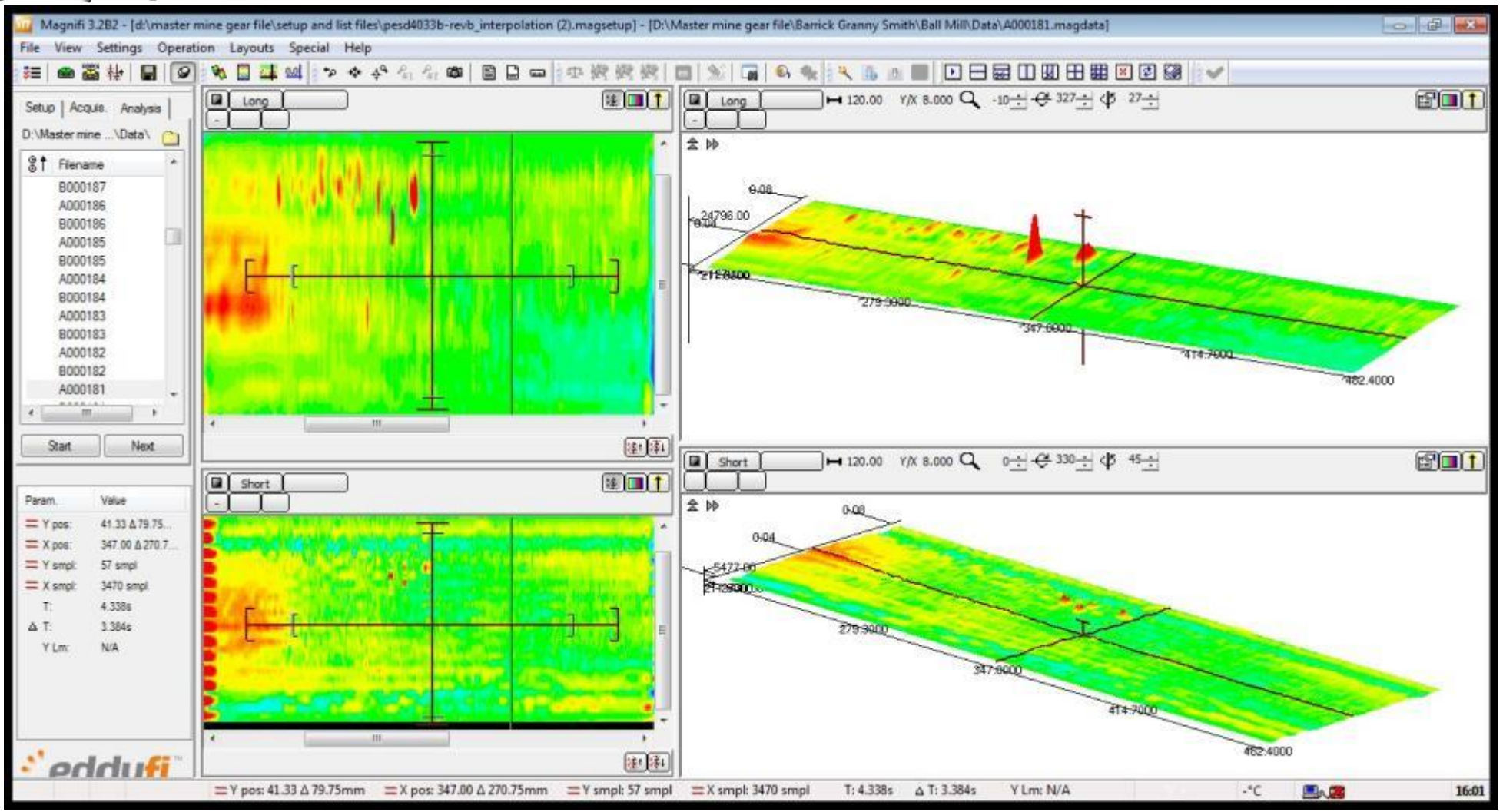


Fig 23 Scan of tooth 181A

Fig 24 Tooth 239 A 2013

Fig 25 Tooth 239 2011

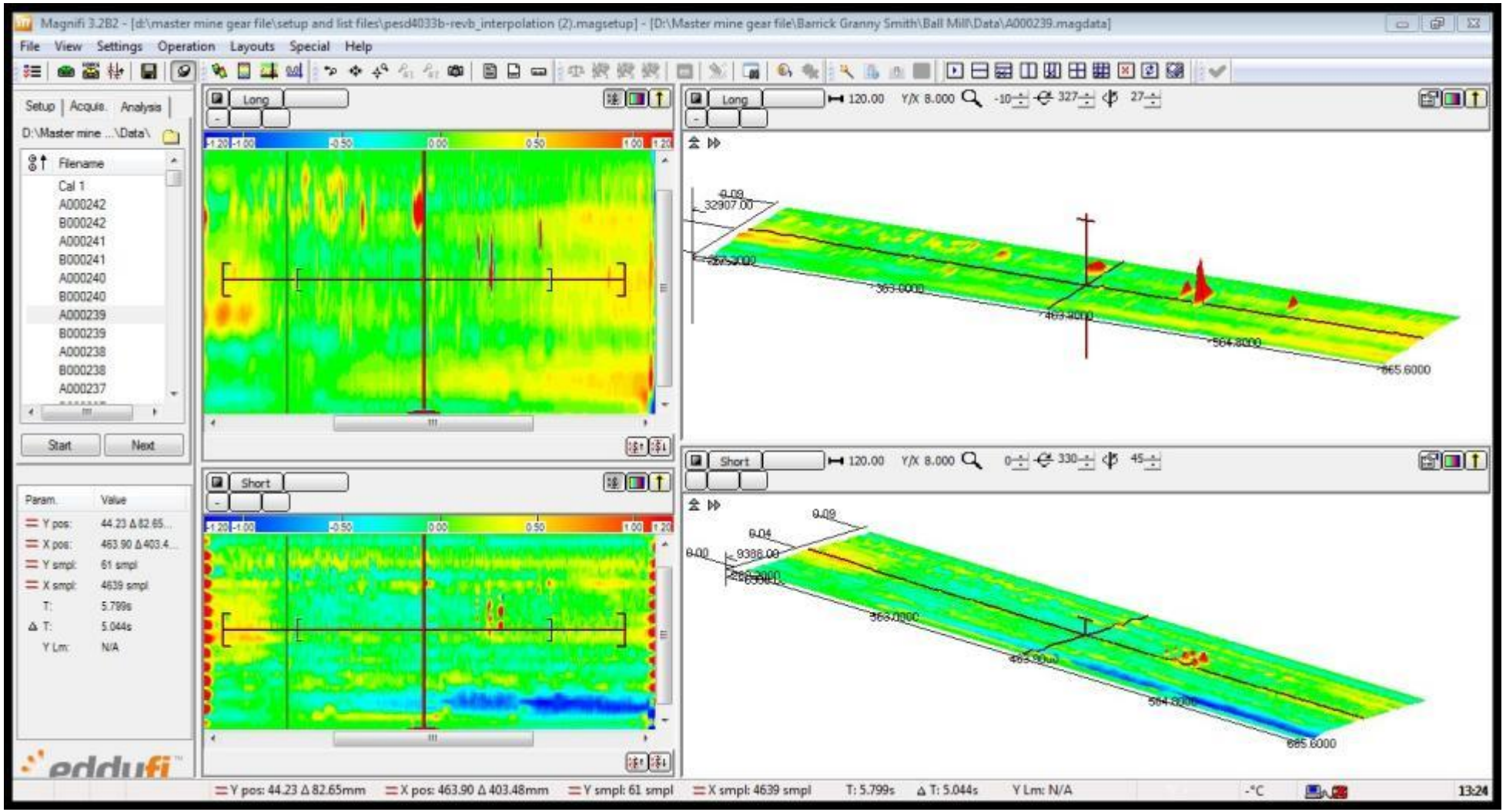


Fig 26 Scan of tooth 239A

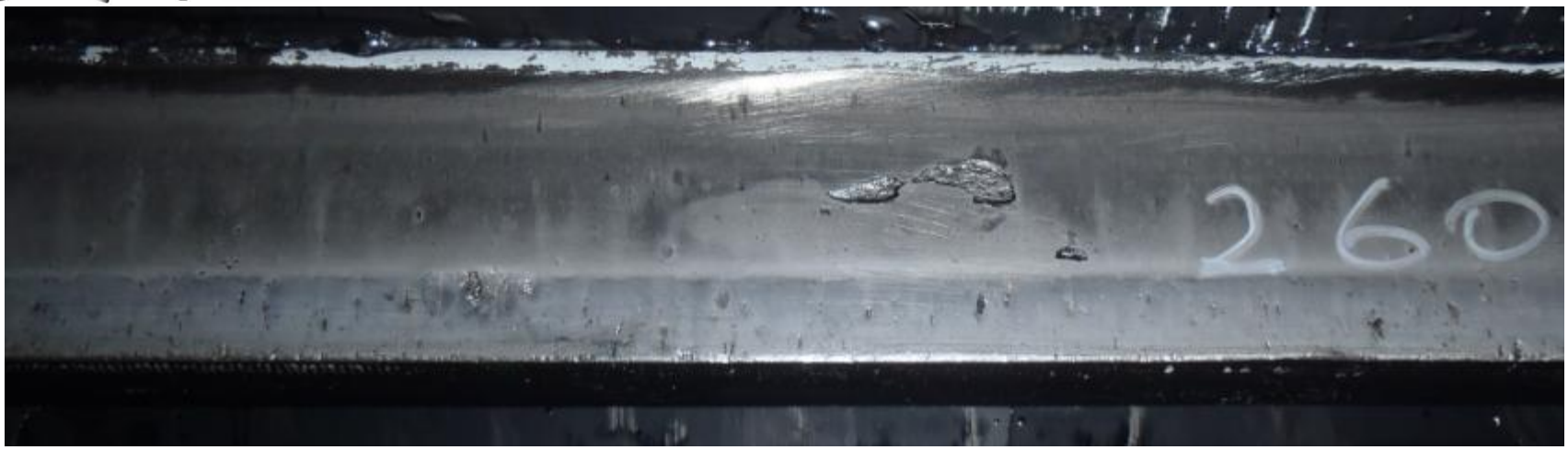


Fig 26a Tooth 260A 2013

Fig 26 b Tooth 260A 2011

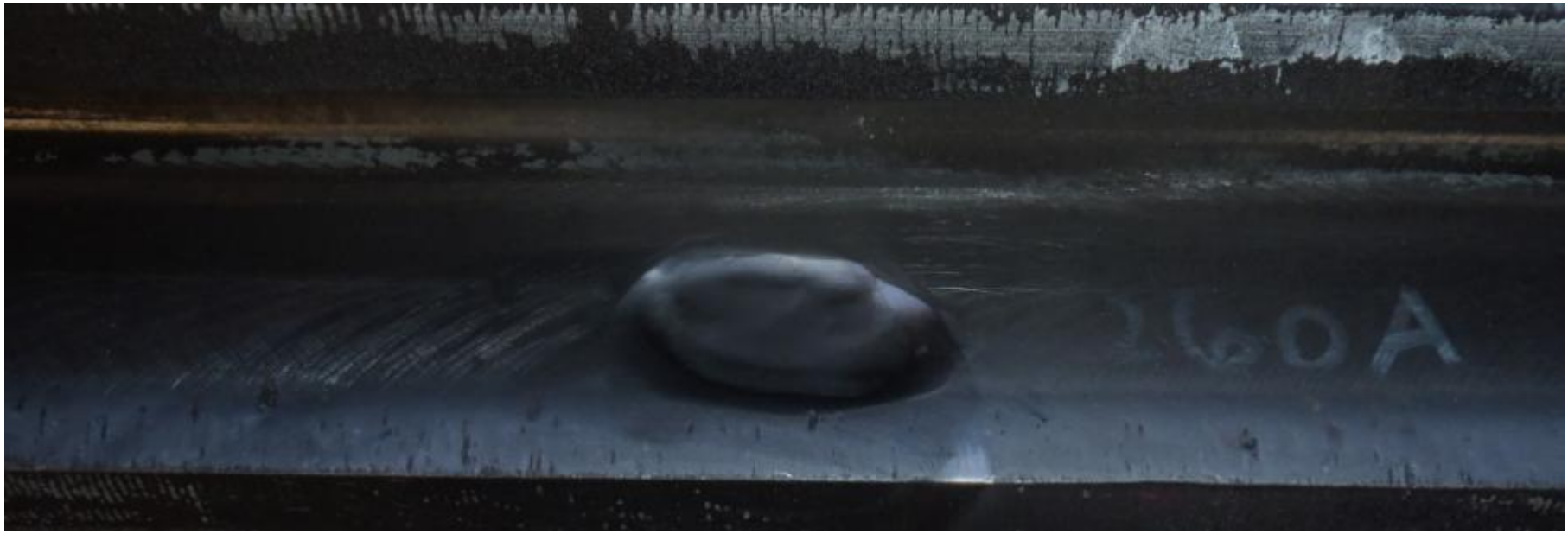


Fig 27 Tooth 260A remediated

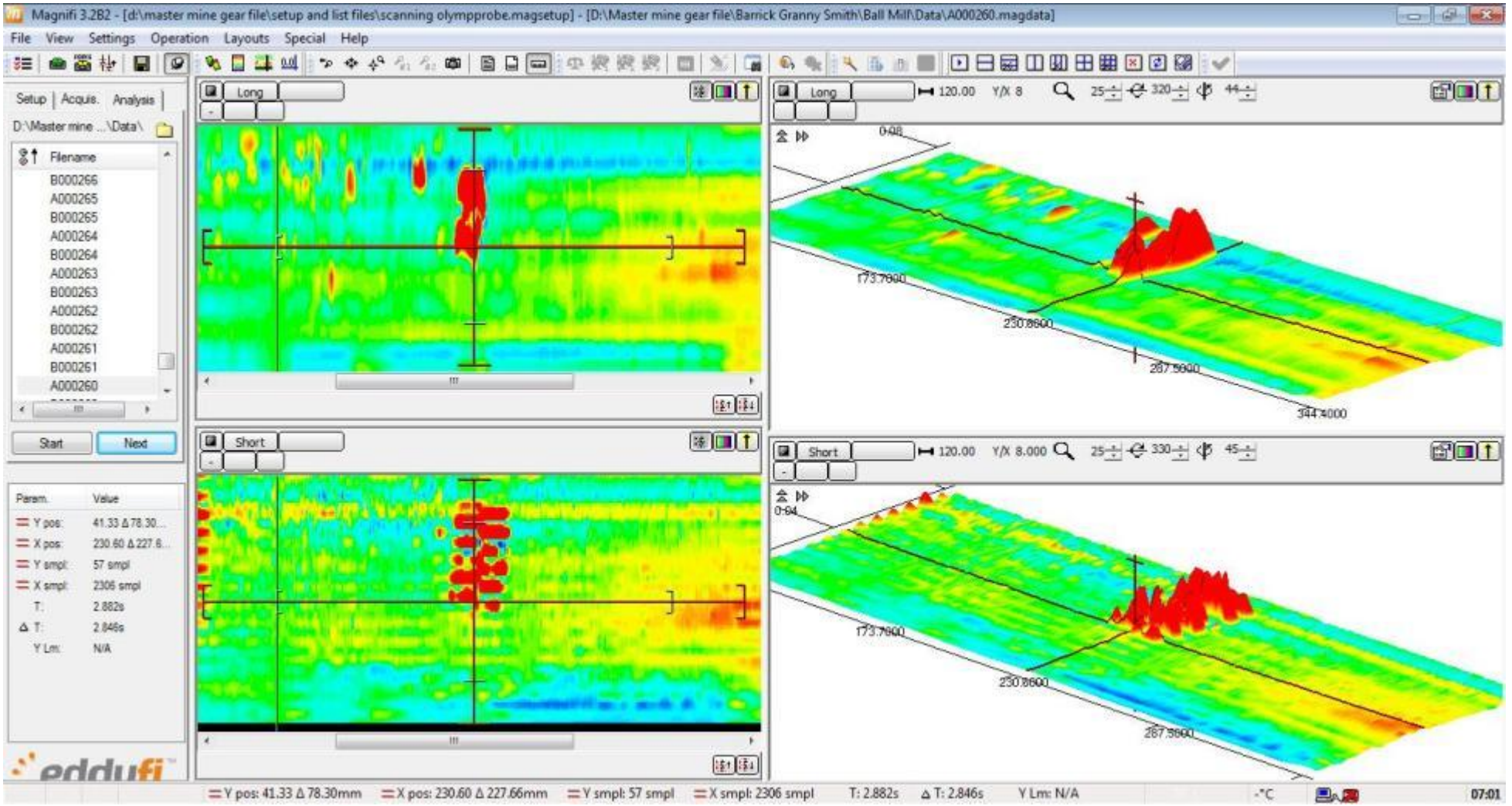


Fig 28 Scan of tooth 260A

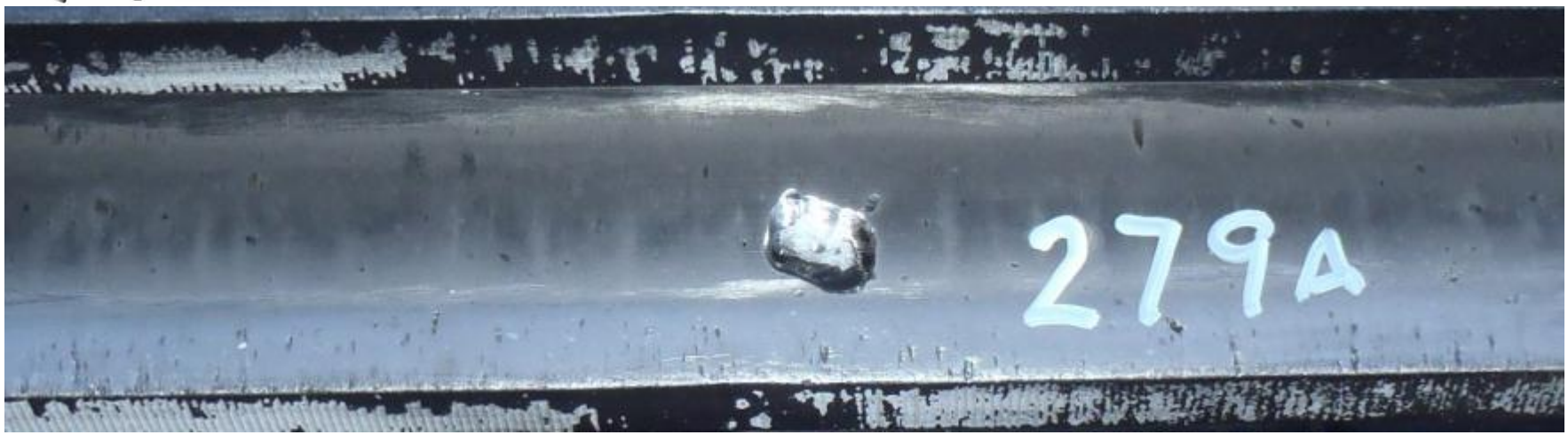


Fig 29a Tooth 279A 2013

Fig 29b Tooth 279A 2011

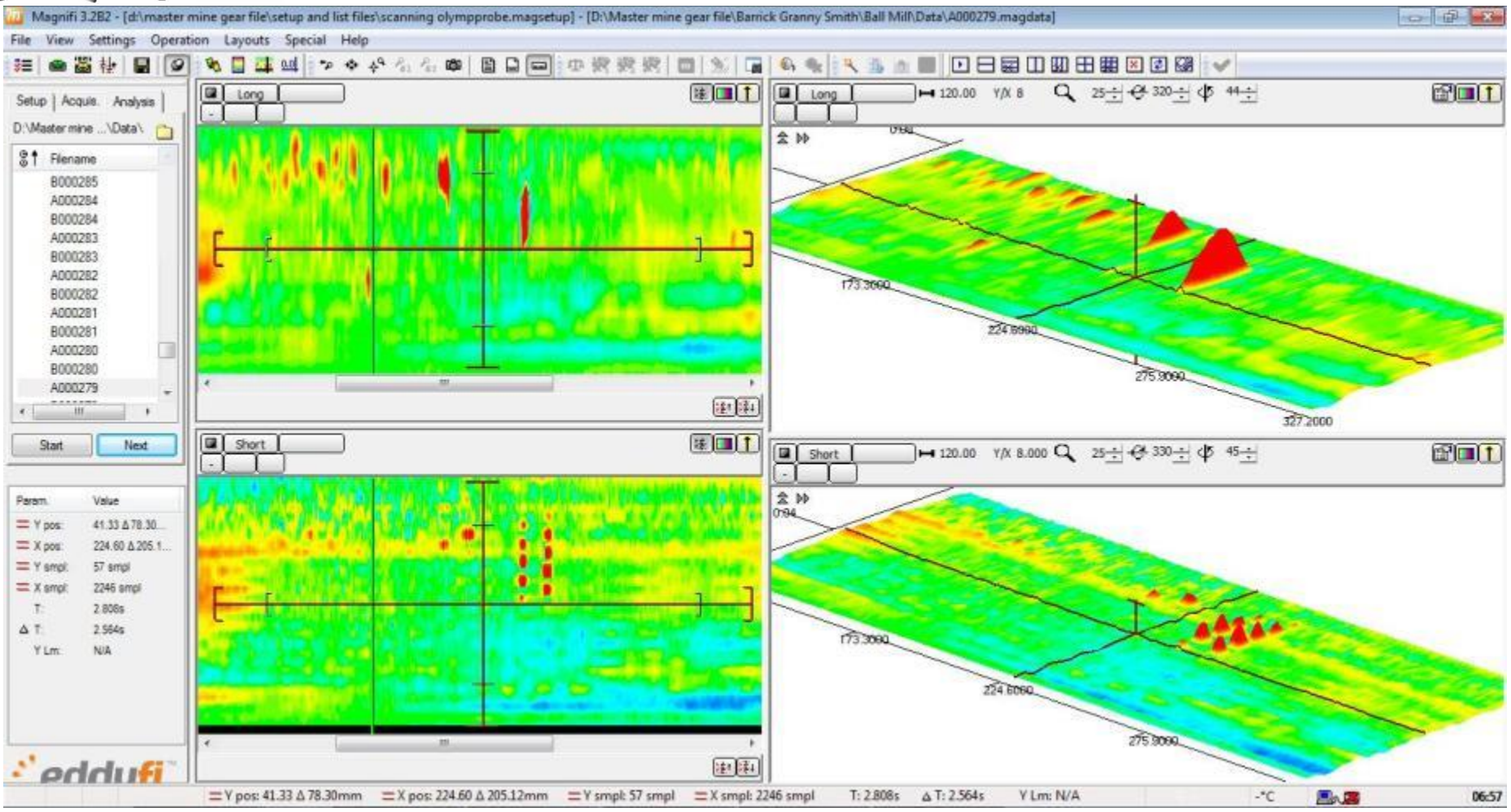


Fig 30 Scan of tooth 279A 2013