

**Emails between Glasgow University, Lancashire County Council and Cuadrilla
October 2014 - June 2015**

Colour codes: **GU** **LCC** **Cuadrilla** Redacted text obtained under FOI January 2016.

Bold names in Cuadrilla list below indicate probable email correspondents with Glasgow University.

Cuadrilla personnel

Lord (John) Browne
Marc Bustin
Huw Clarke
Francis Egan
Mark Miller
Andrew Quarles
Peter Turner
Eric Vaughan

[Cover letter to FOI request]

Please note no correspondence is held between the University and Lord (John) Browne, Marc Bustin, Francis Egan, Mark Miller, or Eric Vaughan.

RE: what direction did you drill the balcome [sic] HZ well to the east or west

Robert Westaway

Sent: 25 August 2014 15:31

To:

Thanks

RW

Dr Rob Westaway

Senior Research Fellow

From: REDACTED

Sent: 25 August 2014 15:30

To: Robert Westaway

Subject: FW: REDACTED what direction did you drill the balcome HZ well to the east or west

Rob

250 W

HZ Length 2720 ft

From: "REDACTED@btinternet.com">

Date: August 25, 2014 at 1:00:02 PM GMT+1

To: "REDACTED" >

Subject: RE: REDACTED what direction did you drill the balcome HZ well to the east or west

Bearing was 250, length 2720 ft

From: REDACTED@msn.com]

Sent: 25 August 2014 12:26

To: REDACTED@btinternet.com

Subject: REDACTED what direction did you drill the balcome HZ well to the east or west
<http://www.southampton.ac.uk/~imw/Petroleum-Geology-Weald-Shale.htm#PGSB-6-3>

REDACTED
REDACTED
REDACTED

From: Paul Younger
Sent: 14 October 2014 21:12
To: Robert Westaway
Subject: Fwd: Representation from REDACTED
Attachments: REDACTED

FYI

Sent from my iPhone

Begin forwarded message:

From: "REDACTED(ENV)" <REDACTED >
Date: 13 October 2014 11:07:32 BST
To: Paul Younger <Paul.Younger@glasgow.ac.uk>
Cc: "REDACTED " <REDACTED@lancashire.gov.uk>, " "
<REDACTED @lancashire.gov.uk>
Subject: Representation from Prof Smythe

Dear Mr Younger

Your details were passed to me by a colleague and I hope you do not mind me contacting you on this matter.

Lancashire County Council is in receipt of planning applications from an oil and gas company called Cuadrilla for the drilling, fracking and extended flow testing of the gas with a direct connection to a local gas transmission pipeline, if extended testing is thought to be viable and is carried out. The applications are accompanied by an Environmental Statement that is extensive. The applications can be viewed on the County Councils website at <http://planningregister.lancashire.gov.uk/>

We have now received many representations on the proposals. The attached representations from David Smythe raises objection on the grounds of geology, seismology, and hydrology.

We note that David Smythe addresses himself as 'Emeritus Professor of Geophysics, University of Glasgow'. I would normally expect representations that claimed an affiliation with the University of Glasgow to be supported by the University, and so I would be grateful if you could consider the matters I raise and advise whether you have any comments.

Thank you and regards, REDACTED

REDACTED Specialist Advisor

Environment Directorate | Lancashire County Council | County Hall | Preston | PR1 0LD

* REDACTED@lancashire.gov.uk

From: Paul Younger [mailto:Paul.Younger@glasgow.ac.uk]

Sent: 14 October 2014 21:10

To: REDACTED (ENV)

Cc: REDACTED ; Robert Westaway

Subject: Re: Representation from

Dear REDACTED

In brief, D K Smythe retired from this University 17 years ago and has no affiliation with the present research team here. He never visits, does not know the researchers here, has no knowledge of contemporary work here, such as that in hydrogeology and induced seismicity (in which myself and Dr Rob Westaway (copied in) have expertise respectively). According to the Science Citation Index, Smythe has not published a peer-reviewed paper on any topic since 2002, and even when he did publish, he never published peer-reviewed papers on the above topics. The University recently wrote to D K

Smythe requesting that he desist from giving the impression he is actively affiliated with us. He never responded, but it would appear he does not intend to respect this request.

Dr Westaway and myself will review the documents you sent, insofar as they fall within our areas of expertise, and give you an objective appraisal from the perspective of the actual Glasgow University research team.

Best wishes

Paul Younger

Prof Paul L Younger FREng

Rankine Chair of Engineering and

Professor of Energy Engineering

University of Glasgow

From: REDACTED (ENV) <REDACTED @lancashire.gov.uk>

Sent: 15 October 2014 16:10

To: Paul Younger

Cc: Robert Westaway

Subject: RE: Representation from REDACTED

Dear Professor Younger and Doctor Westaway

It was very good of you to reply to my enquiry and we thank you for your comments.

We would be grateful of your consideration of REDACTED documents and we appreciate the time that you may take in doing this.

There is no particular deadline but it is likely that we will have to determine the applications before the end of the year

Regards, REDACTED

From: REDACTED

Sent: 17 October 2014 12:03

To: Robert Westaway; REDACTED

Cc: REDACTED paul.younger@gla.ac.uk

Subject: Re: FW: gas analyses

Hi REDACTED

I understand your frustration and spoke with REDACTED yesterday. I am sorry not to have replied before but I have been away and travelling much of the past few weeks.

>From the purely scientific evidence view point we do not have definitive evidence there was no H₂S on the basis of the results that APT generated from Isotubes analysed some time after the gases were collected. That said we think it very unlikely as described in the message I forwarded (that I sent to REDACTED earlier this year). REDACTED and I have discussed checking the mud loggers reports from well site as to what was found when the wells were drilled. H₂S is always a potential safety hazard that is carefully checked for during drilling operations and I would expect there to be drillers data from Draeger or other methods on what was found (or not as the case may be!).

If you just want to state that there is absolutely no evidence that the Carboniferous mudstones contain H₂S I think you can probably state that with some certainty. Does this help.

REDACTED

On 16/10/2014 12:37, Robert Westaway wrote:

Dear all

Sorry to but in, but we need to get moving on this correction as if it is delayed much longer the journal will refuse to consider it as the topic will no longer be current in relation to their original publication.

People from Manchester University have published a paper claiming amongst other things that UK shale gas might well be 'sour' and may thus cause significant levels of air pollution. As part of a rebuttal we would like to publish the attached table showing that a number of zero measurements of hydrogen sulphide have been made by APT.

All the information except the existence of the zero measurements is already in the public domain as it is included in the BGS online borehole archive. We are therefore requesting permission to disclose these zero measurements, please. If you would prefer the names of the well operators to be omitted from the table we would be happy for do that. If anyone else would like to be added to the authorship as owners of the data then we would be happy for that, too. I would have thought that it is in the interests of all concerned to encourage this kind of rational discussion in relation to shale gas, and hope you will agree to this disclosure. Hoping to hear from you in the next day or so.

Best wishes, Rob

Dr Rob Westaway

Senior Research Fellow

From: REDACTED@msn.com]

Sent: 16 October 2014 12:07

To: Robert Westaway; Paul Younger

Subject: FW: gas analyses

FYI

From: REDACTED@cuadrillaresources.com

To:

CC: REDACTED@msn.com

Subject: gas analyses

Date: Thu, 16 Oct 2014 10:54:46 +0000

Any update of the request by to use the Bowland gas analyses in his rebuttal of the Manchester paper ? I think they're keen to get the paper submitted as soon as possible.

Regards, REDACTED

--

APT (UK) Ltd.
2nd Floor, 14 Wynnstay Road
Colwyn Bay
LL29 8NB

From: REDACTED@cuadrillaresources.com]

Sent: 17 October 2014 13:40

To: REDACTED

Cc: Robert Westaway; REDACTED paul.younger@gla.ac.uk

Subject: Re: gas analyses

All

I'm awaiting info from the loggers on the detection limits . Also I have no objection to be cited in the rebuttal

Regards,

Sent from my iPhone

On 17 Oct 2014, at 13:35, "REDACTED " REDACTED> wrote:

Hi REDACTED

I agree and think so but could you,if you haven't already, send us the wording that you propose to use relating to our input in the document you propose to submit soonest.

REDACTED

On 17/10/2014 12:27, Robert Westaway wrote:

Thank you very much for these latest messages.

So is the upshot of this that is is OK for us to cite and use the APT report in the manner we have requested, please? Also, can we please cite REDACTED as a REDACTED to the effect that no hydrogen sulphide was detected at any stage during the Preese Hall operation. If so, it would be most helpful to know the concentration threshold at which the detectors were set, please.

Best wishes, Rob

Dr Rob Westaway

Senior Research Fellow

From: REDACTED@cuadrillaresources.com]

Sent: 17 October 2014 12:09

To: REDACTED Robert Westaway

Cc: REDACTED paul.younger@gla.ac.uk

Subject: RE: FW: gas analyses

I did follow up on the mud loggers reports and I understand there were no direct measurements of H₂S values. A standard warning system was in place for monitoring of danger levels. The alarms were never activated which is consistent with your observations below.

regards, REDACTED

REDACTED

<mime-

attachment.jpg>

Cuadrilla Resources Ltd.

Cuadrilla House, Stowe Court, Stowe Street, Lichfield, Staffordshire, WS13

6AQ, United Kingdom

cuadrillaresources.com

Direct: +44 1543 266 442

Phone: +44 1543 266 444

Mobile: +447590849429

REDACTED@cuadrillaresources.com

From: REDACTED

Sent: 17 October 2014 12:03

To: Robert Westaway; REDACTED

Cc: REDACTED paul.younger@gla.ac.uk

Subject: Re: FW: gas analyses

Hi REDACTED

I understand your frustration and spoke with REDACTED yesterday. I am sorry not to have replied before but I have been away and travelling much of the past few weeks.

>From the purely scientific evidence view point we do not have definitive evidence there was no H₂S on the basis of the results that APT generated from Isotubes analysed some time after the gases were collected. That said we think it very unlikely as described in the message I forwarded (that I sent to REDACTED earlier this year). REDACTED and I have discussed checking the mud loggers reports from well site as to what was found when the wells were drilled. H₂S is always a potential safety hazard that is carefully checked for during drilling operations and I would expect there to be drillers data from Draeger or other methods on what was found (or not as the case may be!).

If you just want to state that there is absolutely no evidence that the Carboniferous mudstones contain H₂S I think you can probably state that with some certainty. Does this help.

REDACTED

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Best wishes, Rob

Dr Rob Westaway

Senior Research Fellow

From: REDACTED@msn.com]

Sent: 16 October 2014 12:07

To: Robert Westaway; Paul Younger

Subject: FW: gas analyses

FYI

REDACTED

REDACTED REDACTED

From: REDACTED@cuadrillaresources.com

To: REDACTED

CC: REDACTED@msn.com

Subject: gas analyses

Date: Thu, 16 Oct 2014 10:54:46 +0000

REDACTED

Any update of the request by REDACTED to use the Bowland gas analyses in his rebuttal of the Manchester paper ? I think they're keen to get the paper submitted as soon as possible.

Regards, REDACTED

--

APT (UK) Ltd.

2nd Floor, 14 Wynnstay Road

Colwyn Bay

LL29 8NB

Tel. & Fax: +44 (0)1492 533 007 [Patrick Barnard on aptec.no website

patrick.barnard@aptuk.co.uk]

Mobile: +44 (0)7876 513 891

Website: www.aptec.no

Applied Petroleum Technology (UK) Ltd., incorporated in England and Wales (company number 5814934).

From: REDACTED@cuadrillaresources.com]

Sent: 21 October 2014 14:25

To: Robert Westaway

Cc: REDACTED; paul.younger@gla.ac.uk

Subject: Re: gas analyses

Rob

Fine by me. I'd really like to have a chat about this stuff.

Have you got a number I can call you on? I'm on 07590 8494/9

all best

REDACTED

Sent from my iPhone

On 21 Oct 2014, at 14:07, "Robert Westaway" <Robert.Westaway@glasgow.ac.uk> wrote:

REDACTED

Please find attached a draft of the commentary that we plan to write, as requested. If I don't hear from you I will assume that it is OK to proceed, since that was the impression created in the most recent of the e-mails sent last week.

Best wishes, Rob
Dr Rob Westaway
Senior Research Fellow

RE: gas analyses

Robert Westaway

Sent: 21 October 2014 14:36

To: REDACTED@cuadrillaresources.com]

Cc: REDACTED; paul.younger@gla.ac.uk

Attachments:qjgeh2014-011proof4-1.pdf (1 MB) ; Corrections to the revise~1.docx (19 KB)

I am working at home today so can be contacted on 01913844502.

By the way, you are also cited as a pers. comm. re Preese Hall in connection with another paper that Paul and I currently have in press, on induced seismicity from fracking. I have attached the current set of proofs as well as a list of corrections that are currently being implemented, to try to eliminate the various mistakes made by the typesetters.

Best wishes, Rob
Dr Rob Westaway
Senior Research Fellow

From: Robert Westaway [mailto:Robert.Westaway@glasgow.ac.uk]

Sent: 17 December 2014 11:31

To: Paul Younger; REDACTED(ENV)

Cc: REDACTED REDACTED

Subject: RE: Representation from REDACTED

REDACTED

Paul Younger and I have just completed the commentary / recommendation document that we promised for you back in October in relation to this.

Please advise how it should be submitted - for example, should I just e-mail it to you as a PDF or do I maybe upload it onto your planning permission website?

Yours, Rob
Dr Rob Westaway
Senior Research Fellow

From: REDACTED(ENV) REDACTED@lancashire.gov.uk]

Sent: 17 December 2014 11:47

To: Robert Westaway; Paul Younger

Cc: REDACTED ; REDACTED

Subject: RE: Representation from REDACTED

Thank you Rob.

If you could email it to me a PDF that would be really helpful.

REDACTED

From: Robert Westaway [mailto:Robert.Westaway@glasgow.ac.uk]

Sent: 17 December 2014 12:25

To: REDACTED(ENV); Paul Younger

Cc: REDACTED; REDACTED

Subject: RE: Representation from REDACTED

REDACTED

Please find attached the report. I have also included a copy of the recent paper by Westaway & Younger on induced seismicity caused by fracking.

Yours, Rob

Dr Rob Westaway

Senior Research Fellow

From: REDACTED(ENV) [REDACTED@lancashire.gov.uk]

Sent: 17 December 2014 14:27

To: Robert Westaway; Paul Younger

Cc: REDACTED; REDACTED

Subject: RE: Representation from REDACTED

Dear Dr Westaway and Professor Younger.

Thank you once again for this. We appreciate the time and the effort that you have spent on this. We are expecting that both applications will be presented to committee for determination at the end of January, at which time the County Council reports will be in the public domain. No doubt you will also be able to follow it in the national news and press.

Regards, REDACTED

From: Robert Westaway [mailto:Robert.Westaway@glasgow.ac.uk]

Sent: 22 January 2015 11:40

To: REDACTED(ENV); Paul Younger

Cc: REDACTED REDACTED

Subject: RE: Representation from REDACTED

REDACTED

I see that the report we wrote is now cited in this document

<http://council.lancashire.gov.uk/documents/s55657/PNR%20report.pdf>. Unfortunately, I cannot find our report on your website any more, which would seem to mean that no-one is able to confirm what it actually says. Is this just a computer glitch? It would be great if our report could be made available, please.

Best wishes, Rob

Dr Rob Westaway

Senior Research Fellow

RE: Representation from REDACTED

REDACTED(ENV) [REDACTED@lancashire.gov.uk]

Sent: 22 January 2015 16:42

To: Robert Westaway

Cc: REDACTED [REDACTED@lancashire.gov.uk]; Paul Younger

Dear Dr Westaway

Thank you for your email

The County Council report that you have referenced is a main cover report and is supported by a number of appendices. In the 'hydrogeology and ground gas' appendix we have been able to record your references much more extensively and in the context of the issue being addressed.

The reports and appendices can be found here

<http://council.lancashire.gov.uk/ieListDocuments.aspx?CIId=118&MIId=4340&Ver=4>

Because we received thousands of representations on each application, we were unable to make all representations available on the county council website because of the sheer volume.

We have prioritised those that are statutory consultees for viewing on the website.

I hope that is understandable and acceptable.

Regards, REDACTED

From: Robert Westaway [Robert.Westaway@glasgow.ac.uk]

Sent: 06 February 2015 12:32

To: REDACTED

Cc: REDACTED@cuadrillaresources.com

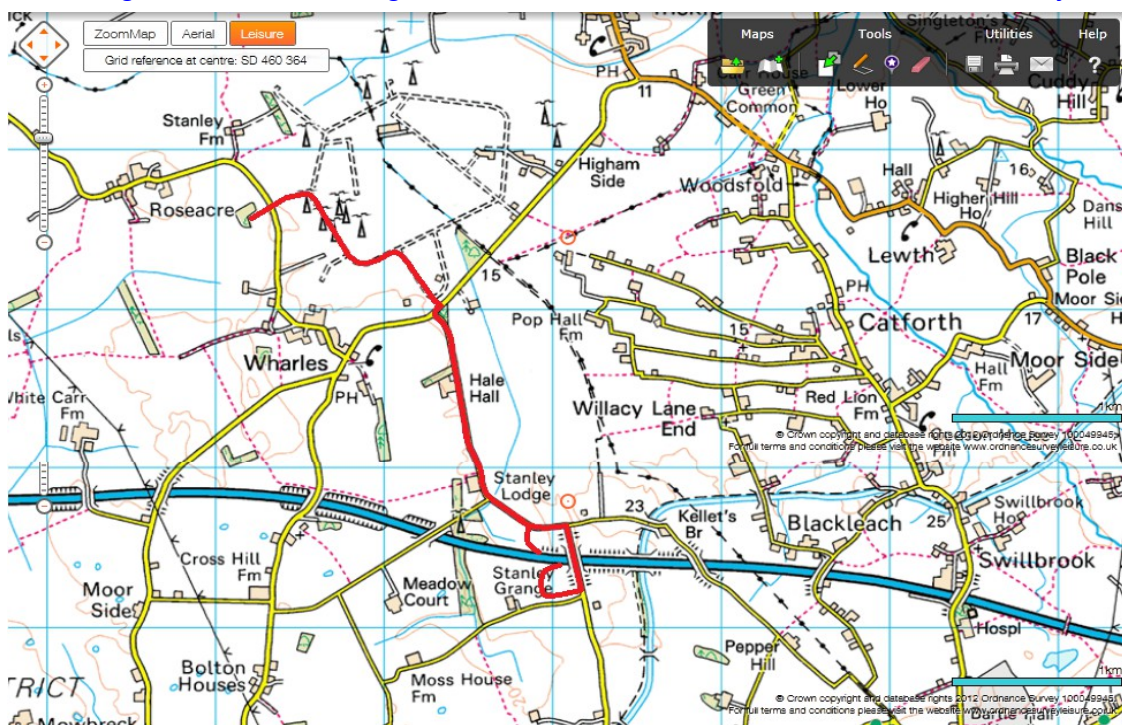
Subject: Lancashire

REDACTED

I have been asked to give yet another talk in Edinburgh next week on shale gas developments. As a result, I have been checking up on the issues underlying the recent recommendation for Lancashire council to reject Cuadrilla's plans. These issues have nothing to do with geology, so it doesn't really need me to talk about them, but what the heck!

My understanding is that both sites are considered to produce excessive noise levels for operations at night, but this is because they have been designed to generate no more than 42 dB of sound at any residential property nearby, which is a standard planning guideline - but the local authority has decided that this is not stringent enough, even though it is quieter than, say, birdsong, and require less than 40 dB. I hope it will be possible to accommodate this change; you might like to know that night-time drilling noise was an issue over getting planning permission for the Science Central borehole in Newcastle. This was initially only granted permission subject to only operating during the working day, so Newcastle University appealed and subsequently got permission for night-time operation as well. This process is documented on the Newcastle City Council website and Paul Younger also knows the full details.

There is also the issue over traffic to and from the Roseacre Wood site. Here, is my understanding, Cuadrilla have agreed that there should be no more than 25 lorry



movements in any day during 12 weeks and no more than 5 lorry movements in any day at other times, and that these movements can take place across the nearby disused Inskip airfield to avoid the road through the villages of Roseacre and Wharles, but these numbers are still considered excessive. Having looked at local maps, it would seem that whatever route is then followed, several other villages would still be on the way before the nearest main road is reached. A possible solution would be to build a temporary junction with the nearby M55 motorway, possibly as depicted on the attached map. The turnouts might need to face the other way instead, or in addition to, those depicted if vehicle movements between Roseacre Wood and the Preston New Road site are necessary. To

enable this, there might be a requirement for a temporary speed limit on the motorway or an agreement not to use the temporary junction at busy times.

These temporary roads would need planning permission, but I am pretty sure there are precedents for doing this kind of thing, for example to allow access to and from motorways that are being rebuilt. I can also recall that sometime ago (1995, maybe?) a temporary junction was built on the A1 trunk road in Yorkshire to allow water tankers to easily get in and out of a site to collect water when there was a serious water shortage in a neighbouring area.

It might also be worth noting that in the 1970s the runways at Inskip airfield were dug up and the concrete and gravel recycled for the foundations for the M55 motorway. That must have involved the movement of several hundred thousand tonnes of material, and so would almost certainly have required far more lorry movements than the present shale gas plans do. No-one seems to have objected to that. It might thus be worthwhile looking up in archives exactly what route these movements took - it was presumably onto the motorway formation at a nearby point via a temporary junction, possibly somewhere near the one I am now suggesting.

Maybe you can pass these suggestions on to the folks at Cuadrilla - I hope this helps!

Best wishes, Rob

Dr Rob Westaway

Senior Research Fellow

RE: Lancashire

[REDACTED]

Sent: 10 February 2015 15:15

To: Robert Westaway

Cc: REDACTED@cuadrillaresources.com

Morning Rob

I don't know the exact details of the Cuadrilla issues, but I'm sure REDACTED does.

This is duly passed on to them via REDACTED email

Good luck with your talks

Cheers

REDACTED

REDACTED REDACTED

REDACTED REDACTED

From: REDACTED@cuadrillaresources.com]

Sent: 15 May 2015 16:37

To: Robert Westaway

Subject: Hello

Professor Westaway,

I was very interested in your and your co-authors submission to Applied Energy "Comment on 'Life cycle environmental...". Your scientific contribution to the often over-heated UK shale gas debate is very much appreciated.

I have spoken with Prof Younger about visiting Glasgow to establish a line of communication. Would you be interested in meeting? We would be happy to discuss our current drilling program and timing or any other items that you might be interested in.

Regards,

REDACTED

Cuadrilla Resources Ltd.

Cuadrilla House, Stowe Court, Stowe Street, Lichfield, Staffordshire, WS13 6AQ, United Kingdom

cuadrillaresources.com

Phone: +44 1543 266 444

Mobile: +44 7738 766 137

From: Robert Westaway [mailto:Robert.Westaway@glasgow.ac.uk]
Sent: 15 May 2015 16:51
To: REDACTED
Cc: paul.younger@gla.ac.uk
Subject: RE: Hello
REDACTED

Thank you very much for this. I am really glad you liked our paper, and would very much welcome the opportunity to meet. Things are quite hectic over the next few weeks, however. On the week after next, 25-29 May, I will be away with students in the field. Next week I will be in London on Wednesday and Thursday, but could possibly make a meeting on Friday assuming there are no glitches over sorting out the equipment for the field trip the following week. On 1-2 June I am already tied up, but could possibly meet on 3 June. After that, things get less hectic.

Maybe if you can suggest a possible date that would suit you, then Paul and I can check our availability?

I do hope it will be possible to arrange something soon.

Best wishes, Rob
Dr Rob Westaway
Senior Research Fellow

From: REDACTED
Sent: 22 May 2015 15:40
To: Robert Westaway
Cc: paul.younger@gla.ac.uk; REDACTED
Subject: Re: Hello

Rob,

Thanks for those dates. I will ask REDACTED , REDACTED to finalise dates.

Thanks,

REDACTED

Sent from my iPhone

On 18 May 2015, at 11:11, Robert Westaway <Robert.Westaway@glasgow.ac.uk> wrote:
I am currently free on both those ranges of dates. I don't know about Paul, though.

In principle, a meeting between 9 and 11 June would suit me better, if this is at all possible, not least because the following week will be the first of a six-week closure of the main railway line between Glasgow and Edinburgh for engineering work. This will make it difficult to travel between these two cities, but some such travel will be unavoidable, so I am trying to keep commitments during this span of time to a minimum to avoid knock on effects of travel delays.

Looking forward to meeting you.

Yours, Rob

Dr Rob Westaway
Senior Research Fellow

From: REDACTED@cuadrillaresources.com]
Sent: 22 May 2015 16:10
To: Robert Westaway; paul.younger@gla.ac.uk
Cc: REDACTED
Subject: RE: Hello

Good afternoon,

I have inserted a couple of 'holds' into REDACTED's diary for 9 and 10 Jun in the hope that we can confirm either of these dates. REDACTED needs to be in London for the afternoon of 11 Jun so that day may be a little tight.

I look forward to hearing from you.

Kind regards,

REDACTED

From: Robert Westaway [mailto:Robert.Westaway@glasgow.ac.uk]

Sent: 22 May 2015 16:18

To: REDACTED paul.younger@gla.ac.uk

Cc: REDACTED

Subject: RE: Hello

Dear all

Paul is on holiday until Tuesday so can we finalize this then, please?

My own travel arrangements would make a morning meeting before ~11:00 on any of these days a bit awkward. Putting this together with REDACTED s constraint would preclude 11 June, I guess, unless that is the only day when Paul is free.

Yours, Rob

Dr Rob Westaway

Senior Research Fellow

From: REDACTED REDACTED@cuadrillaresources.com]

Sent: 29 May 2015 09:54

To: paul.younger@gla.ac.uk; Robert Westaway

Cc: REDACTED

Subject: Possible Meeting with Prof Younger/Dr Westaway & REDACTED (Cuadrilla)

Good morning Prof Younger/Dr Westaway,

Prof Younger – sorry to trouble you but please could you let me know if you would be available to meet with REDACTED on either 9 or 10 Jun in Glasgow? If unfortunately, this isn't possible then REDACTEDs still happy to meet with Dr Westaway – if that's still suitable?

I look forward to hearing from you so I can secure the date in the diary.

Kind regards,

REDACTED

From: Robert Westaway [mailto:Robert.Westaway@glasgow.ac.uk]

Sent: 01 June 2015 15:46

To: REDACTED paul.younger@gla.ac.uk

Cc: REDACTED

Subject: RE: Possible Meeting with Prof Younger/Dr Westaway & REDACTED (Cuadrilla)

It was just announced that the rail strike planned for 9 June has been cancelled. 9 June is the best day for Paul, so can we confirm this please? REDACTED if you arrive anytime from 12 or 12:30 onwards I can take you to lunch. Paul will be free from 2 pm so we can all meet for the rest of the afternoon.

Looking forward to meeting you.

Best wishes, Rob

Dr Rob Westaway

Senior Research Fellow

From: REDACTED

Sent: 02 June 2015 09:16

To: 'Robert Westaway'; paul.younger@gla.ac.uk

Cc: REDACTED

Subject: RE: Possible Meeting with Prof Younger/Dr Westaway & REDACTED (Cuadrilla)

Hi Rob,

That sounds like a plan for Thu 9 Jun. I'm going to look at REDACTED's flight options to Glasgow and will let you know what time he's due to land once sorted.

Thanks very much.

Kind regards,

REDACTED

From: REDACTED@cuadrillaresources.com]

Sent: 03 June 2015 15:11

To: Robert Westaway; paul.younger@gla.ac.uk

Cc: REDACTED

Subject: RE: Possible Meeting with Prof Younger/Dr Westaway & REDACTED (Cuadrilla)

Hi Both,

As promised, I can confirm REDACTED's flights are now booked. He will also be bringing REDACTED with him. They should be out of the airport for around 1100 hrs. Rob - is it best for REDACTED to come and meet you at Glasgow University for 1200 hrs? If so, please could you let me have the exact details? If you have an alternative plan, then please let me know.

Thanks very much.

Kind regards,

REDACTED

From: Robert Westaway [mailto:Robert.Westaway@glasgow.ac.uk]

Sent: 10 June 2015 10:48

To: REDACTED paul.younger@gla.ac.uk

Cc: REDACTED ; REDACTED

Subject: RE: Possible Meeting with Prof Younger/Dr Westaway & REDACTED (Cuadrilla)
REDACTED

It was great to meet you both yesterday.

In the discussion you used a particular term for the time-delay between fluid injection and induced seismicity - you called it the '<something> effect'. Could you please remind me of the term and point me to any available documents that use this term. Furthermore, you indicated that you have a preferred explanation, for Preese Hall, but we never got back to discussing what it was. Could you possibly elaborate, please?

Best wishes, Rob

Dr Rob Westaway

Senior Research Fellow

RE: Possible Meeting with Prof Younger/Dr Westaway & REDACTED (Cuadrilla)

REDACTED@cuadrillaresources.com]

Sent: 10 June 2015 10:57

To: Robert Westaway; REDACTED@cuadrillaresources.com]; paul.younger@gla.ac.uk

Cc: REDACTED@cuadrillaresources.com]

Hi Rob,

Was good to meet you also. Its referred to as the trailing affect. To my understanding this is an observatoon that can be backed up by modelling due to this type of induced seismicity occurring from a geometric effect. In other words there is a time delay due to the time it takes for a fault to have elevated pore pressure over a sufficient area to reduce the effective normal stress allowing shear stress to take over. It was observed at Preese Hall, also the other classic case is Basel.

There is some information in the geotechnical study of Preese hall, some information in Clarke et al, otherwise I think there are numerous papers on the Basel geothermal project.

Regards,

REDACTED