NOTE: This disposition is nonprecedential.

United States Court of Appeals for the Federal Circuit

PGS GEOPHYSICAL AS,
Appellant

v.

ANDREI IANCU, UNDER SECRETARY OF COMMERCE FOR INTELLECTUAL PROPERTY AND DIRECTOR OF THE UNITED STATES PATENT AND TRADEMARK OFFICE,
Intervenor

2017-1582

Appeal from the United States Patent and Trademark Office, Patent Trial and Appeal Board in No. IPR2015-00313.

Decided: June 18, 2018

JESSAMYN SHELI BERNIKER, Williams & Connolly LLP, Washington, DC, argued for appellant. Also represented by DAVID I. BERL, DAVID M. KRINSKY, JAMES MATTHEW RICE, CHRISTOPHER ALAN SUAREZ.

THOMAS W. KRAUSE, Office of the Solicitor, United States Patent and Trademark Office, Alexandria, VA,

argued for intervenor. Also represented by NATHAN K. KELLEY, MONICA BARNES LATEEF, MEREDITH HOPE SCHOENFELD.

Before LOURIE, CLEVENGER, and REYNA, *Circuit Judges.*

CLEVENGER, *Circuit Judge*.

PGS Geophysical AS ("PGS") appeals the final written decisions of the Patent Trial and Appeal Board ("the Board") in an *inter partes* review ("IPR") proceeding instituted by WesternGeco LLC ("WesternGeco").[1] In its first decision, the Board invalidated claims 1, 4, 10 and 11 of U.S. Patent No. 6,026,059 ("'059 Patent") as being anticipated or obvious in light of the prior art. Further, after granting WesternGeco's request for rehearing, a majority of the Board invalidated dependent claim 2 by associating its limitation to one step in independent claim 1 (which was taught by the prior art), over PGS's arguments that the limitation applied to a different step in claim 1 (which was not taught by the prior art). We agree with the Board as to the invalidity of claims 1, 4, 10 and 11, but disagree with the majority of the Board as to claim 2.

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[1] While PGS's appeal before this court was pending, the parties settled and WesternGeco withdrew from the appeal. *See* WesternGeco's Unopposed Mot. to Withdraw at 1 (Aug. 5, 2017), ECF No. 25; Order at 1–2 (Aug. 7, 2017), ECF No. 26. The United States Patent and Trademark Office subsequently intervened pursuant to 35 U.S.C. § 143 and properly became the party-at-interest in this appeal. *See* Notice of Intervention by the U.S. Pat. & Trademark Off. at 1 (Aug. 7, 2017), ECF No. 27; *Knowles Elecs. LLC v. Iancu*, 886 F.3d 1369, 1371 (Fed. Cir. 2018).

BACKGROUND

The '059 Patent concerns three-dimensional seismic surveying and processing of the resultant data. Seismic survey data is generated and acquired using source-receiver pairs; a series of "sources" are physically placed in an array relative to a series of "receivers." The sources emit a "shot" via vibrations or explosions, which travels through the target geology and bounces off geological features before returning to the receivers. Figure 1 below shows a representative seismic survey diagram and "generalized waveform response"—known as a "trace"—picked up by the receiver. *See* J.A. 144. When a shot bounces off of a geological feature, it produces a spike in the trace signal's amplitude relative to the background noise. Data processors then collect these trace signals and utilize a variety of techniques to increase the resolution and accuracy of the survey, in essence turning discrete signal spikes into subsurface maps.

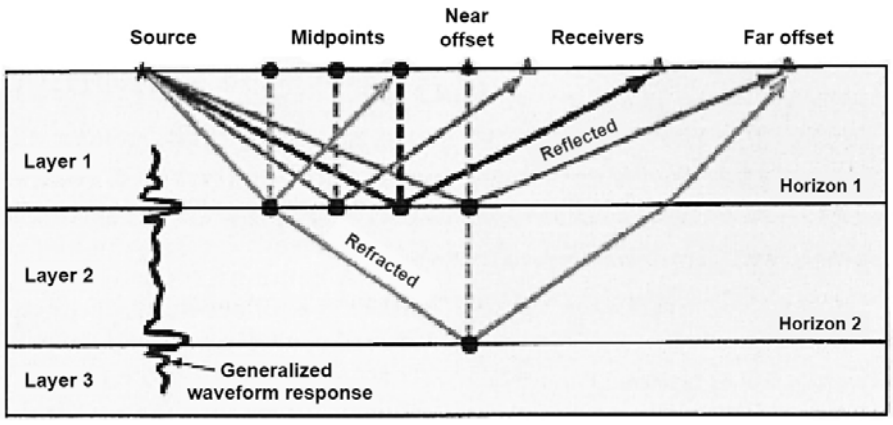

Fig. 1. Simplified diagram of seismic principle used in exploration

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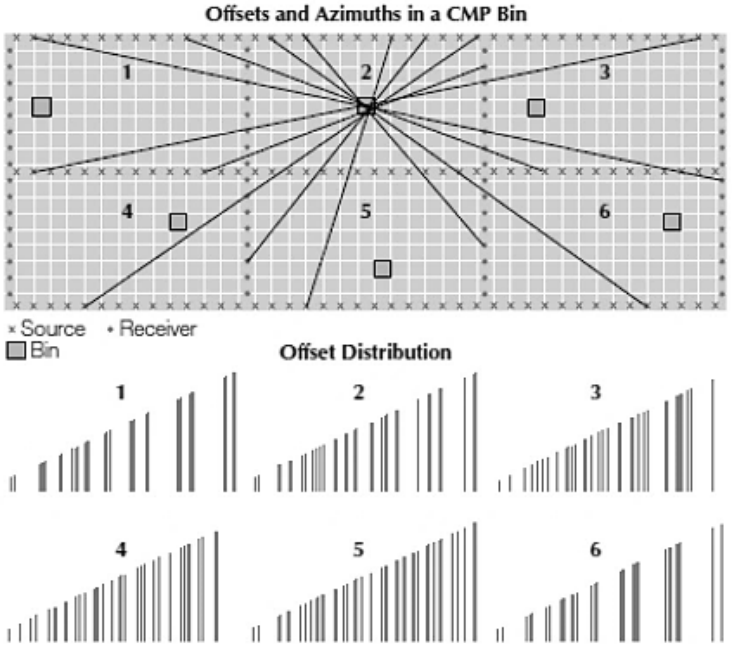
One metric by which data processors measure the resolution of a survey is through the signal-to-noise ratio—the ratio of signal strength (i.e. signal carrying relevant information) to background noise. For three-

dimensional seismic surveys, data processors often increase this ratio using a process called binning, which groups traces together by some shared feature. For instance, traces may be grouped into common midpoint bins (CMBs)—containing traces that have the same lateral midpoint between their source-receiver pairs—or common reflection point bins (CRPs)—containing traces that have the same subsurface reflection point between their source-receiver pairs. CMBs are generally used for simple sub-surface geometries, whereas CRPs may be used for more complex geometries.

Each bin has a particular "fold," which is the number of traces within the bin. Each trace within the bin also has a particular "offset"—the distance between the source and receiver that produced the trace—and "azimuth"—the angle between the offset line and some reference axis. The figure below depicts an overhead view of a bin, where each line passing through the reference point at "2" represents a single trace. *See* J.A. 642. By "stacking" (i.e. summing) numerous traces having a common reference point (i.e. midpoint or reflection point), the amplitude of the signal becomes more pronounced relative to the amplitude of the noise, thereby increasing the signal-to-noise ratio and overall resolution of the survey.



However, bins generally contain non-uniform offset and azimuth distributions, as shown in the figure. In other words, traces may be more concentrated at certain offsets or azimuths, rather than evenly distributed about the reference point. In the figure, bin 2 contains numerous traces from mid-distance source-receiver pairs, but far fewer traces from both the nearest and furthest source-receiver pairs. According to the '059 Patent, these non-uniform distributions negatively impact the analysis of the stacked trace data. In particular, variations that arise when normalizing[2] the amplitude of each trace subsequently impact the amplitudes of the stacked traces.

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[2] In seismic surveying, shots lose energy as they propagate through the target geology. This means that geological features further from the source produce weaker signal spikes relative to the background noise. Amplitude normalization is a process that accounts for this energy loss by adjusting the amplitude of identifiable

The '059 Patent purports to solve the problem of non-uniform offset and azimuth distributions by having traces evenly distributed around a bin's reference point. According to the '059 Patent, each bin is assigned a coordinate system, where each trace in the bin is given coordinate values based on the source-receiver pair's position in the array. These coordinate values may then be plotted in a "spider" graph, as shown in Figure 6 of the '059 Patent (annotations added).

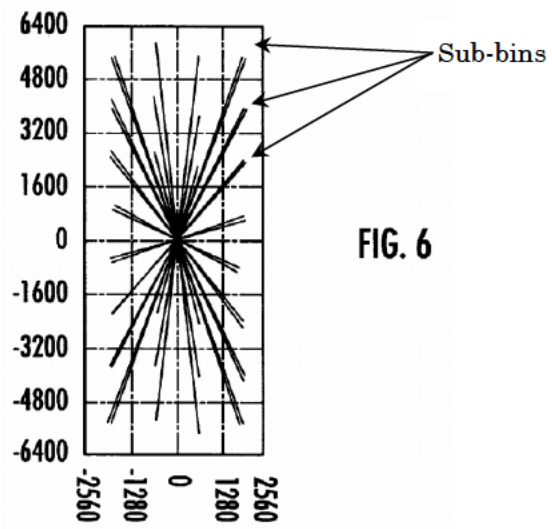

FIG. 6

Once the coordinate system has been assigned, the '059 Patent teaches a process of generating a series of smaller "sub-bins" within the coordinate system. According to the '059 Patent, the goal is for each sub-bin to contain the same number of traces; each sub-bin is "regularized."[3] For example, each sub-bin in Figure 6 contains

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signals relative to the background noise to "normalize" all of the signals within a trace. In other words, amplitude normalization may make weaker signal spikes more pronounced relative to the background noise.

[3] The Board construed the term "regularized" to mean "uniform." In other words, all sub-bins within a

two traces. The process of generating sub-bins with the same number of traces ensures each bin has sufficient offset and azimuth diversity to increase the signal-to-noise ratio, and that those traces are uniformly distributed within each bin so as to avoid problems caused by amplitude normalization.

WesternGeco filed a petition requesting an IPR of claims 1–12 of the '059 Patent. The Board instituted the IPR only as to claims 1-5, 10 and 11. Although the Board erred in failing to institute the IPR on every claim WesternGeco challenged, *SAS Inst., Inc. v. Iancu*, 138 S. Ct. 1348, 1354 (2018), neither the Appellant nor the Intervenor complain about this failure, *PGS Geophysical AS v. Iancu*, Nos. 16-2470, 16-2472, 16-2474, slip op. at 11–13, 2018 WL 2727663 at *5–6 (Fed. Cir. June 7, 2018) (noting that the Board's partial institution decision is a waivable error). Claim 5 was upheld, and is not implicated in this appeal.

Independent claim 1 of the '059 Patent discloses a method of generating bins with regularized sub-bins. The relevant claims at issue read as follows:

> 1. A process for generating a bin of common midpoint traces from a three dimensional seismic survey data set, each of the traces having a shot location and a receiver location associated therewith, the process comprising:
>
> gathering from the data a plurality of traces having a common reference point . . . ;
>
> assigning a coordinate set to a plurality of traces in the common reference point bin, wherein the coordinates are associated

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particular bin have the same number of traces contained therein. The parties do not challenge this construction.

with the shot position and the receiver position associated with the traces . . . whereby a coordinate designated set of traces is defined; and

organizing the coordinate-designated set of traces into a set of bins having a regularized number of traces.

2. A process as in claim 1, wherein a plurality of the coordinate-designated set of traces have the same coordinates.

3. A process as in claim 2, further comprising adding a plurality of traces having the same coordinates.

4. A process as in claim 1, wherein each trace has a unique set of coordinates.

10. A process as in claim 1 wherein the common reference point comprises a common midpoint.

11. A process as in claim 1 wherein the common reference point comprises a common reflection point.

'059 Patent, col. 5 l. 48–col. 6 l. 4; col. 6 ll. 20–23.

In its first written decision, the Board found that claims 1, 4 and 10 were anticipated under 35 U.S.C. § 102 by U.S. Patent No. 4,933,912 ("Gallagher"). Gallagher discloses a method of improving the signal-to-noise ratio in CMB data processing by ensuring the selected traces have diverse offsets and azimuths. Gallagher, col. 1 ll. 51–54. Gallagher selects particular traces by: (1) choosing a desired number (n_1) of folds in a particular CMB, (2) assigning a coordinate system to the bin's trace data, (3) generating a number (n_2) of angular sections (i.e. lines A and B, below) in the coordinate system, and (4) generating a number (n_3) of concentric shells (dashed concentric circles, below) in the coordinate system. *Id*. at col. 5 l. 15–

col. 6 l. 67. Preferably, n_2 and n_3 are selected such that $n_2 \times n_3 = n_1$. *Id.* at col. 8 ll. 3–4. In other words, if a CMB with a fold of sixteen is desired, Gallagher teaches generating four sections (i.e. quadrants) and four concentric shells, thereby producing sixteen section-shell regions (i.e. sub-bins). After creating the section-shell regions, Gallagher teaches (5) selecting a single trace from each section-shell region, and (6) stacking the selected traces. *Id.* at col. 6 l. 68–col. 7 l. 41; col. 8 ll. 48–55. If one region does not contain a trace (because no eligible source or receiver was physically within the *post hoc* region), a second trace may be selected from any other region. *Id.* at col. 7 ll. 49–59. As shown in Figure 1 of Gallagher (annotations added), the use of sections ensures the selected traces have varying azimuths, while the use of concentric shells ensures they have varying offsets.

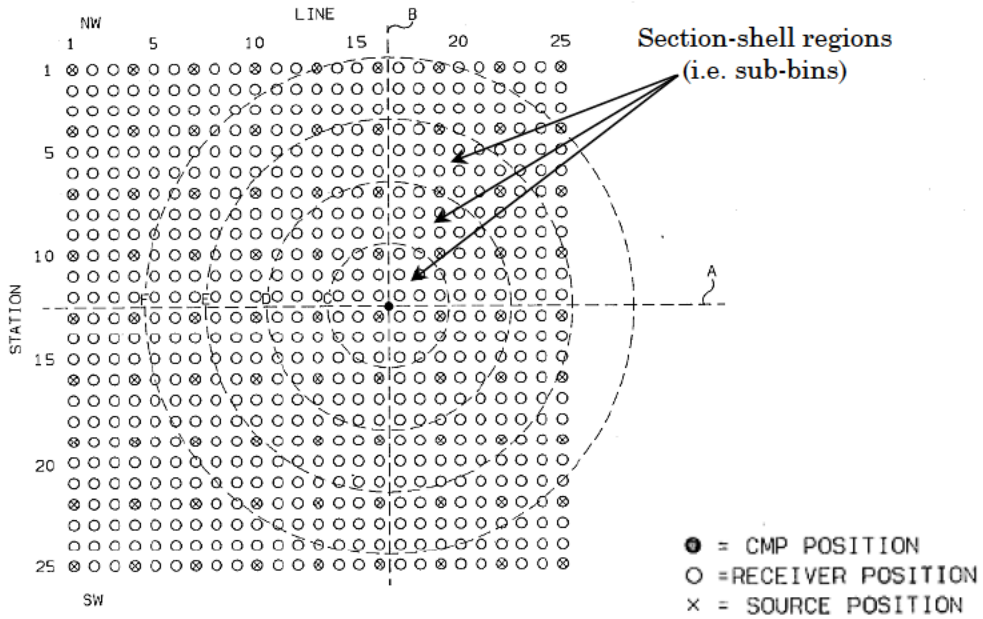

FIG. 1

Throughout the IPR, PGS attempted to distinguish Gallagher by arguing that the "organizing" step of claim 1 requires organizing all available traces, and does not

permit ignoring or discarding traces. Thus, according to PGS, Gallagher did not teach the "organizing" step of claim 1 because Gallagher generally selects a single trace from each section-shell region and ignores all others. But in finding claim 1 invalid, the Board summarily rejected these arguments.

Further, PGS did not dispute that if Gallagher teaches the "organizing" step of claim 1, claims 4 and 10 are also invalid because Gallagher's process results in a single trace in each section-shell region and utilizes CMBs, respectively. The Board initially refused to invalidate claims 2 and 3, however, based on the assumption that the '059 Patent required each regularized sub-bin to contain a plurality of traces—a limitation not taught by Gallagher.

The Board also invalidated claim 11 as being obvious in view of Gallagher and U.S. Patent No. 4,596,005 ("Frasier"). The Board relied on Frasier only because it taught using CRP gathers instead of conventional CMB gathers when surveying complex geologies. Frasier, col. 21 l. 67–col. 22 l. 7. The Board rejected PGS's arguments that the combination was improper, pointing out its limited reliance on Frasier and that neither Gallagher nor Frasier teaches away from the claimed invention, but merely address different aspects of trace data processing.

After the first written decision issued, WesternGeco requested a rehearing based on the Board's analysis of claim 2. The Board granted the request, and subsequently issued a divided second decision, with a majority invalidating claim 2 over a dissent by the author of the initial decision.

In the second decision, the majority reasoned that claim 2 should be associated to the "assigning" step of claim 1, rather than the "organizing" step, because that is where "a coordinate-designated set of traces" is first defined. In other words, the majority understood the

claim to require a plurality of traces before the "organizing" step, but not necessarily after. The majority thus determined that Gallagher anticipated claim 2 because it taught a plurality of traces in areas that would later become section-shell regions (i.e. sub-bins) even though Gallagher ultimately selected only one trace per region.

The dissent did not dispute that the term "coordinate-designated set of traces" was defined in the assigning step, but that the "organizing" step modified the "set of traces" from the "assigning" step by arranging them into regularized sub-bins. In other words, the dissent understood the claim to require a plurality of traces in each sub-bin after the "organizing" step. The dissent relied heavily on the teachings of the specification, the surrounding claims, and the evidence of record, and charged the majority with considering only the "plain language," without context.

We have jurisdiction pursuant to 28 U.S.C. § 1295(a)(4)(A) (2012); *see PGS Geophysical AS*, Nos. 16-2470, 16-2472, 16-2474, slip op. at 9 (concluding that appellate jurisdiction exists over final Board decisions arising from a partial institution).[4]

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[4] We asked the parties for additional briefing on the issue of appellate jurisdiction. Both parties found no impediment to our jurisdiction, while noting that the Board in this case erred in failing to institute the IPR on all of the claims asserted in the petition. *See SAS Inst.*, 138 S. Ct. at 1354 (requiring that the Board address all claims asserted in a petition upon instituting an IPR). Neither party seeks a remand pursuant to which the Board would be required to adjudicate the claims on which the IPR was not instituted.

A

PGS first challenges the Board's construction of the term "organizing," and whether Gallagher anticipates the "organizing" step of claim 1. We affirm the Board's decision.

We review the Board's claim construction rulings *de novo*, *In re Cuozzo Speed Techs., LLC*, 793 F.3d 1268, 1279–80 (Fed. Cir. 2015), applying the broadest reasonable interpretation.[5] 37 C.F.R. § 42.100(b) (2016); *Cuozzo Speed Techs., LLC v. Lee*, 136 S. Ct. 2131, 2142 (2016). Under the broadest reasonable interpretation, the words of the claim must be given their plain meaning, unless such meaning is inconsistent with the specification. *Trivascular, Inc. v. Samuels*, 812 F.3d 1056, 1062 (Fed. Cir. 2016) (citing *Straight Path IP Grp., Inc. v. Sipnet EU S.R.O.,* 806 F.3d 1356, 1362 (Fed. Cir. 2015)).

Anticipation under 35 U.S.C. § 102 is a question of fact, which we review for substantial evidence. *Blue Calypso, LLC v. Groupon, Inc.*, 815 F.3d 1331, 1341 (Fed. Cir. 2016). Substantial evidence is "something less than the weight of the evidence but more than a mere scintilla" and is "such relevant evidence as a reasonable mind might accept as adequate to support a conclusion." *In re Mouttet*, 686 F.3d 1322, 1331 (Fed. Cir. 2012). "Where

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[5] While we review the claim construction applying broadest reasonable interpretation, we note that the outcome would be the same under the standard set forth in *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005). *See* Changes to the Claim Construction Standard for Interpreting Claims in Trial Proceedings Before the Patent Trial and Appeal Board, 83 Fed. Reg. 21,221 (May 9, 2018) (proposing a rule to use the same claim construction standard during IPR proceedings as that used by district courts).

two different conclusions may be warranted based on the evidence of record, the Board's decision to favor one conclusion over the other is the type of decision that must be sustained by this court as supported by substantial evidence." *In re Bayer Aktiengesellschaft*, 488 F.3d 960, 970 (Fed. Cir. 2007).

The question we must answer is whether the Board erred in holding that the term "organizing," as used in claim 1 of the '059 Patent, includes ignoring or discarding traces. It is undisputed that Gallagher ignores or discards traces after creating section-shell regions (i.e. subbins). Thus, if the "organizing" step of claim 1 does not preclude ignoring or discarding traces, Gallagher anticipates the claim. But if all traces assigned coordinates in the "assigning" step must be placed into *regularized* subbins in the "organizing" step, without ignoring or discarding any traces, PGS argues that Gallagher cannot anticipate the claim, because Gallagher ignores or discards some traces. Thus, applying the broadest reasonable interpretation, we must discern the meaning of the term "organizing" in the context of the '059 Patent.

PGS concedes that the Patentee did not act as a lexicographer by giving a special definition to the word "organizing." Oral Argument at 9:58. PGS also recognizes that the ordinary English language definition of "organizing" may include acts such as ignoring or discarding, but argues that the claim term must nonetheless exclude such acts. J.A. 882; Oral Argument at 2:27. According to PGS, the '059 Patent's "organizing" step uses all available traces, so the patent should not be understood to allow any form of "organizing" that ignores or discards trace data. PGS at bottom is arguing that the "organizing" step must preclude such acts. But nothing in the specification of the '059 Patent supports PGS's argument, and PGS failed to produce an expert opinion that the ordinary artisan in this art would necessarily understand that "organizing" must mean rearranging data without ignor-

ing or discarding any data. If the Patentee had intended to prohibit ignoring or discarding traces in the "organizing" step, it would have been easy to do so.

We first examine the intrinsic evidence—the '059 Patent itself and prosecution history—to determine whether the term "organizing" precludes ignoring or discarding traces. We find no such support in the '059 Patent or prosecution history. The only support PGS provides is that: (1) "a coordinate-designated set of traces" is defined in the "assigning" step, (2) the same "coordinate-designated set of traces" is organized in the "organizing" step, and (3) ignoring or discarding data is supposedly contrary to the purpose of the invention.

The specification, however, fails to address how traces—which may be non-regularized at the time of data acquisition—are processed and organized into regularized sub-bins without ignoring or discarding trace data. On the one hand, the specification teaches that offset distributions cannot be regularized at the data acquisition stage. '059 Patent, col. 1 ll. 31–40 ("[I]t is seen that the offset distribution is not uniform. This pattern is dependent on the acquisition geometry, and this non-uniform pattern has not been found to be avoidable. Changing the acquisition geometry to accommodate offset distribution in the [CMBs] is not practical."). On the other hand, the specification provides an exemplar that seemingly generates traces that would produce regularized sub-bins at the acquisition stage. *Id.* at col. 4 ll. 1–5 ("In this example, the acquisition geometry resulted in two traces populating each common-inline/common-crossline bin . . . ."). Yet nowhere has PGS alleged that merely associating the azimuth to each trace automatically transforms a non-regularized offset distribution to a regularized sub-bin distribution. In short, there is no teaching that all of the traces gathered are assigned coordinates in the "assigning" step, or that all traces in the "assigning" step end up in sub-bins after the "organizing" step.

Without any clear meaning based on the intrinsic evidence, we may then look to extrinsic evidence to see whether the term "organizing" precludes ignoring or discarding. *See Helmsderfer v. Bobrick Washroom Equip., Inc.*, 527 F.3d 1379, 1382 (Fed. Cir. 2008) ("A court may look to extrinsic evidence so long as the extrinsic evidence does not contradict the meaning otherwise apparent from the intrinsic record.") (citation omitted). PGS admits that it did not act as its own lexicographer to define "organizing," but nonetheless argues that using dictionary definitions rids the term of all context provided by the '059 Patent. While dictionaries may not resolve the plain meaning of a term in a patent, they may be helpful, especially as to how one of ordinary skill in the art would understand the term. *See id.* ("When the intrinsic evidence is silent as to the plain meaning of a term, it is entirely appropriate . . . to look to dictionaries or other extrinsic sources for context—to aid in arriving at the plain meaning of a claim term.").

Dictionaries define the term "organize" to mean: "to undergo physical or organic organization . . . to arrange elements into a whole of interdependent parts," Merriam-Webster's Collegiate Dictionary 819 (10th ed. 1993), "to systematize; order," Random House Webster's College Dictionary 953 (1991), "to put together into an orderly, functional, structured whole . . . [t]o arrange in a coherent form; systematize . . . [or t]o arrange in a desired pattern or structure," The American Heritage Dictionary 1275 (3d ed. 1992). None of these definitions explicitly preclude ignoring or discarding as a part of "organizing."

At oral argument, PGS clarified whether the '059 Patent ever envisioned ignoring or discarding traces. PGS's attorney first reiterated that all traces assigned to the coordinate system at the "assigning" step are subsequently organized, without ignoring or discarding any traces. Oral Argument at 7:03. But PGS's attorney later clarified that some traces acquired during a survey may be ignored

prior to the "gathering" or "assigning" step in order to produce regularized sub-bins. Oral Argument at 26:29. In other words, PGS is attempting to distinguish Gallagher by claiming that the '059 Patent may ignore trace data early in its process, but not between the "assigning" and "organizing" steps.

We do not find this distinction compelling. Nothing in the '059 Patent or dictionary definitions limits the scope of the term "organizing" to preclude ignoring or discarding trace data. Nor does the specification require any such ignoring or discarding to occur prior to the "gathering" or "assigning" steps. The fact that the '059 Patent envisions ignoring or discarding traces to regularize its sub-bins is enough to conclude that the term "organizing" may allow for ignoring or discarding traces. To hold otherwise would be to read in a preclusive limitation not present in the claim. *Liebel-Flarsheim Co. v. Medrad, Inc.*, 358 F.3d 898, 904 (Fed. Cir. 2004) (citing *Arlington Indus., Inc. v. Bridgeport Fittings, Inc.,* 345 F.3d 1318, 1327 (Fed. Cir. 2003); *Gart v. Logitech, Inc.,* 254 F.3d 1334, 1343 (Fed. Cir. 2001)).

And even if ignoring or discarding traces cannot be considered part of the "organizing" step, the claim is not limited to only the steps recited. *See Dow Chem. Co. v. Sumitomo Chem. Co.*, 257 F.3d 1364, 1380 (Fed. Cir. 2001) ("It is fundamental that the use of th[e] phrase [comprising] as a transitional phrase does not exclude additional unrecited elements, or steps (in the case of a method claim).") (internal quotation marks omitted); *see also In re Affinity Labs of Tex., LLC*, 856 F.3d 902, 907 (Fed. Cir. 2017) (noting that use of the term "comprising" "signals that the breadth of [the method claim] allows for additional steps interleaved between the recited steps," and that the Board did not err in concluding that the claim does not prohibit additional, intervening steps between those recited); *Exergen Corp. v. Wal-Mart Stores, Inc.*, 575 F.3d 1312, 1319 (Fed. Cir. 2009) (finding that a

claim requiring a particular method step was anticipated by prior art that performed additional steps because of the claim's use of "comprising"). Thus, it would not be improper to consider ignoring or discarding traces as an additional, unrecited step that occurs prior to or during the "organizing" step.

Since the '059 Patent does not preclude ignoring or discarding traces as part of the "organizing" step, we agree that Gallagher anticipates claim 1. Gallagher teaches a process of assigning a coordinate system to traces, thereby defining a coordinate-designated set of traces (i.e. by graphically representing the physical array locations), and organizing those traces into regularized sub-bins (i.e. by generating section-shell regions, and ignoring or discarding some trace data). Thus, we affirm the Board's decision invalidating claim 1.

B

Next, PGS challenges the Board's majority decision on rehearing to associate the limitation of claim 2 with the "assigning" step—as opposed to the "organizing" step—of claim 1. This too is a matter of claim construction, which we review *de novo*. *In re Cuozzo Speed Techs., LLC*, 793 F.3d at 1279-80.

Claim 2 recites the limitation "wherein a plurality of the coordinate-designated set of traces have the same coordinates." '059 Patent, col. 5 ll. 65–67. As the majority noted, "a coordinate-designated set of traces" is first defined in the "assigning" step of claim 1. *Id.* at col. 5 ll. 56–62 ("assigning a coordinate set to a plurality of traces . . . whereby a coordinate-designated set of traces is defined . . . ."). But the same limitation is recited again in the "organizing" step. *Id.* at col. 5 ll. 63–64 ("organizing the coordinate-designated set of traces into a set of bins having a regularized number of traces . . . ."). The ques-

tion is which step the limitation in dependent claim 2 modifies.[6]

On rehearing, the Board's majority answered this question by associating the limitation of claim 2 to the first recitation of "a coordinate-designated set of traces" in the "assigning" step of claim 1. As a result, the majority's claim construction required a plurality of traces before the "organizing" step, but not necessarily after. The majority concluded that Gallagher anticipated claim 2, despite the fact that Gallagher's regularized sub-bins contain a single trace post-organizing, because Gallagher taught a plurality of traces prior to its "organizing" step. Upon review, we reverse the majority's decision.

The specification and surrounding claims make clear that the limitation in claim 2 should be associated with at least the "organizing" step of claim 1. First, Figure 6 of the '059 Patent shows a plurality of traces having the same coordinates (i.e. are in the same sub-bins) after the "organizing" step. Second, the specification uses the exact language of claim 2 when describing a final, organized set of traces within sub-bins having a plurality of traces. '059 Patent, col. 3 l. 62–col. 4 l. 1 ("In [the example of Fig. 5], there is a constant fold of two traces per coordinate

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[6] Determining which recitation of "coordinate-designated set of traces" in claim 1 that claim 2 modifies does not require rewriting or reading additional limitations into the claim, as the Board's majority would believe. Because the recitations are identical, our task is merely to decide where to "plug" the limitation of claim 2 into claim 1, as informed by the specification. *Liebel-Flarsheim Co.*, 358 F.3d at 904 (discussing the "twin axioms regarding the role of the specification in claim construction[:]" (1) that claims must be read in light of the specification; but (2) that limitations from the specification may not be read into the claims).

bin . . . [wherein] a plurality of the coordinate-designated set of traces have the same coordinates."). The specification thus evinces that a plurality of traces having the same coordinates exists both before and after the "organizing" step, not just before.

An examination of the surrounding claims supports this interpretation. For instance, claim 3, which depends from claim 2, provides an additional step of "adding a plurality of traces having the same coordinate." *Id.* at col. 6 ll. 1–2. While one could presumably add traces having the same coordinates before organizing the traces into sub-bins, the specification also explicitly states that the traces are added after the organizing step. *Id.* at col. 4 ll. 3–5 ("In this example, the acquisition geometry resulted in two traces populating each common-inline/common-crossline bin, and, according to a further embodiment of the invention, such traces are added to increase the signal to noise ratio."). Further, as the specification makes clear, claim 4 discloses an alternative embodiment where each sub-bin contains only a single trace post-organizing. *Id.* at col. 4 ll. 5–7; col. 6 ll. 3–4. Taking all of these factors together, claim 2 should be associated with at least the "organizing" step of claim 1. Thus, Gallagher does not anticipate the claim because it does not teach a "plurality of the coordinate-designated set of traces" after the "organizing" step.

Another way of looking at the question also arose during oral argument. In essence, when applying the broadest reasonable interpretation to claim 2, the limitation appears to fit comfortably into both the "assigning" and "organizing" step of independent claim 1. Nothing in the specification suggests doing so would be improper and, in fact, it positively supports such an interpretation. *See* '059 Patent, col. 3 l. 62–col. 4 l. 1 (disclosing a plurality of traces having the same coordinates both before and after the "organizing" step).

Furthermore, the typical rule of dependent claims is that they "refer[] to a claim previously set forth and then specify a further limitation of the subject matter claimed." 35 U.S.C. § 112 (1975). The Manual of Patent Examining Procedure ("MPEP") generally requires that a patent claim "provide explicit antecedent basis" for each term. MPEP § 2173.05(e) (6th ed. Rev.3, July 1997); *see Energizer Holdings, Inc. v. Int'l Trade Comm'n*, 435 F.3d 1366, 1370 (Fed. Cir. 2006) (looking to the MPEP and noting that the requirement for antecedent basis is a rule of patent drafting). Thus, we observe that when a claim limitation has multiple antecedent recitations, the limitation may apply equally to each previous recitation so long as such an interpretation is not inconsistent with the specification or claims. Viewed in this light, Gallagher again does not anticipate claim 2, because it does not teach a "plurality of the coordinate-designated set of traces" both before and after the "organizing" step.

C

Finally, PGS challenges the Board's conclusion that Gallagher and Frasier render claim 11 obvious. Obviousness under 35 U.S.C. § 103 is a legal conclusion based on underlying factual findings. *In re Gartside*, 203 F.3d 1305, 1316 (Fed. Cir. 2000). As with anticipation, "[t]he scope and content of the prior art . . . are determinations of fact" that are reviewed for substantial evidence, *In re Mouttet*, 686 F.3d at 1330–31, but the ultimate legal conclusion of obviousness is reviewed without deference. *In re Elsner*, 381 F.3d 1125, 1127 (Fed. Cir. 2004).

While PGS argues there was no expectation of success in combining the prior art, that Gallagher and Frasier address different problems, that the Board provided only conclusory statements, and that it improperly shifted the burden to PGS to disprove obviousness, we find none of these arguments compelling.

Claim 11 states: "the common reference point [of claim 1] comprises a common reflection point [("CRP")]." '059 Patent, col. 6 ll. 22–23. While PGS attempts to frame the issue as an extensive combination of Gallagher and Frasier, the Board relied upon Frasier only because it expounded on the use of CRP gathers to account for nonsymmetrical travel paths and incident and reflected signals in CMB gathers. The '059 Patent only briefly discusses the differences between CRP and CMB gathers, and substantial evidence supports the Board's finding of a motivation to combine the two references—to account for "complex subsurface structure containing dipping reflectors [that] may produce inadequate subsurface coverage maps." J.A. 24 (quoting Petitioner's motivation to combine); *see also* J.A. 27 (adopting Petitioner's motivation to combine). We believe the motivation provided by the Board is sufficient, and did not shift the burden of disproving obviousness to PGS. Therefore, we affirm the final decision of the Board invalidating claim 11.

AFFIRMED-IN-PART AND REVERSED-IN-PART

COSTS

No costs.