

<BrianQ> well, here is an interesting demo of that process that I kept because y'all might be interested:

<BrianQ> <http://pvcdrom.pveducation.org/MANUFACT/CZ.HTM>

[21:09] <MoDo> Brian ... Have you had a chance to read the new "report" on magnitism in tourmaline?

[21:09] <Doos> ok ok

[21:09] <BrianQ> I did

06[21:09] * Doos shuts

[21:09] <BrianQ> I just put up the Czochralski link for fun.

[21:10] <MoDo> Even I'm beginning to wonder about his research.

01[21:10] <@Spauwe> ghehe

01[21:10] <@Spauwe> let's make that another chat

01[21:10] <@Spauwe> Brian we're all ears

[21:10] <Doos> there is another great fun pulling method to create synth corundum: "Stephanov" .. now that we are posting out of the blue

06[21:10] * Doos listens

[21:10] <BrianQ> Now... disclaimer: this is not my field of research

[21:11] <BrianQ> and I have not kept up with any controversy!

[21:12] <BrianQ> my solid state (now called "condensed matter") experience is limited, because I was an atomic and single molecule researcher

[21:12] <BrianQ> and we can't keep up with everything ;)

[21:12] <MoDo> Wow! I'm going to start calling you "Brain" instead of Brian!

[21:13] <BrianQ> That typo is done by accident so often already, it isn't funny!

[21:13] <MoDo> It won't be a typo!

[21:13] <BrianQ> heh

[21:13] <Crystal2> Steve's dyslexic and does it all the time

[21:14] <BrianQ> So I just thought I'd go into this idea people want to know something about by starting pretty simple:

[21:15] <BrianQ> How does a "foreign" atom migrate into an initially "uniform crystal material"?

[21:16] <BrianQ> crystals represent the "condensed matter" that forms gems.

03[21:16] * GemGuest72 (n=fn-javac@host69-53-127-106.birch.net) has joined #gemology

[21:16] <Crystal2> Welcome GemGuest72

[21:16] <BrianQ> We have presumably seen representations of crystals as little balls connected by sticks... kind of tinkertoy arrangements

[21:17] <Doos> yes

[21:17] <MoDo> I can identify with Tinker Toys

01[21:17] <@Spauwe> hi gemguest72, to change your name type /nick and then a very unique name we just started, so you haven't missed much

[21:17] <BrianQ> You could imagine a cube, with the balls at the corners, and the sticks as the sides?

[21:18] <Doos> yes

[21:18] <DragonStek> yes

[21:18] <MoDo> Yep

[21:18] <Crystal2> yes

01[21:18] <@Spauwe> ja

[21:18] <BrianQ> Seems then, like a lot of space in the middle, maybe easy to stick something in that space.

[21:18] <BrianQ> an atom or whatnot.

[21:18] <BrianQ> But that is a false picture of crystals.

[21:19] <BrianQ> Let's take a look at a chart of atom sizes. It might help us... copy and paste in a new window or new tab

[21:19] <BrianQ>

http://www.crystallmaker.com/support/tutorials/crystallmaker/resources/VFI_Atomic_Radii.jpg

[21:20] <MoDo> Cool!

01[21:20] <@Spauwe> very

[21:20] <DragonStek> ok

[21:20] <Crystal2> very cool!

[21:20] <BrianQ> Frank... what about you :)

02[21:20] * GemGuest72 (n=fn-javac@host69-53-127-106.birch.net) Quit (Client Quit)

[21:20] <Bonkycat> Very nice chart

🕒03[21:20] * GemGuest22 (n=fn-javac@host69-53-127-106.birch.net) has joined #gemology

[21:21] <Frankj> It's coming ...I've got it

[21:21] <Bonkycat> Much more information than the little teaser of it in Gems

[21:21] <BrianQ> Thanks, but you know... I didn't make it myself :)

[21:22] <BrianQ> ok, then... now the way these atoms arrange themselves in crystals... for example the cubic arrangement I was talking about...

🕒03[21:22] * Dreamcatcher3 (n=fn-javac@ool-182f106c.dyn.optonline.net) has joined #gemology

[21:22] <BrianQ> The atom would have its center in the corner of the cube, then its edge would be at the halfway point down the side.

[21:23] <BrianQ> So basically it is ball stacked against ball.

[21:23] <BrianQ> and a crystal cell, in that sort of picture is actually filled rather tightly by the atoms.

[21:23] <Frankj> by edge you mean the outer limit of the electron cloud

[21:23] <BrianQ> yes Frank

[21:23] <Frankj> ty

[21:24] <BrianQ> But mostly we can ignore the quantum mechanical details and think of these things as hard billard balls.

[21:25] <BrianQ> This is the "rigid lattice" and "atomistic" view of crystals, and since it has names...

[21:25] <BrianQ> there must be other views as well that I don't go into.

[21:26] <BrianQ> Anyways, there is "chemistry" which is the (quantum) mechanics of why some balls prefer to stick with others.

🕒02[21:27] * Gloribell (n=fn-javac@ip24-254-173-81.rn.hr.cox.net) Quit ("Java user signed off"🕒)

[21:27] <BrianQ> Then there is also some (quantum) differentiation between size of atoms and ions... a positive ion of sodium is much smaller than an atom of sodium (that's the example always used).

🕒03[21:27] * Gloribell (n=fn-javac@ip24-254-173-81.rn.hr.cox.net) has joined #gemology

[21:28] <BrianQ> But given the general chart of atom sizes, let's take a look at some things...

[21:28] <BrianQ> What is chemical makeup of corundum?

[21:28] <Bonkycat> Al Oxide

[21:28] <BrianQ> exactly

[21:28] <BrianQ> let's compare Al atom and O atom sizes....

[21:29] <BrianQ> Al is number 13 and O is number 8

[21:29] <MoDo> Oxygen is so much smaller

[21:29] <BrianQ> quite a significant difference, wouldn't you say!

[21:30] <Bonkycat> yes

[21:30] <Crystal2> yes

[21:30] <BrianQ> basically, a crystal of Al Oxide is formed with a big fat atom in the middle surrounded by a cluster of small oxygen atoms.

[21:30] <BrianQ> a "unit crystal", I should say...

[21:31] <BrianQ> Then the material is stacks of these "unit crystals" in each direction.

[21:31] <BrianQ> Now... let's look at some of the common ... what are they called ... "impurities".. ?

01[21:31] <@Spauwe> yep

01[21:32] <@Spauwe> 'trace elements'

[21:32] <Doos> dopants

[21:32] <BrianQ> um... chromium is one such

[21:32] <BrianQ> that is number 24...

[21:32] <BrianQ> check out its size...

[21:33] <BrianQ> you are not going to replace an oxygen atom with Cr...

[21:33] <BrianQ> O atom doesn't give up enough space to allow the Cr...

[21:33] <BrianQ> You have to have a vacancy in the Al space to fit the Cr... is this imaginable?

[21:34] <Doos> yes

[21:34] <MoDo> Yes

[21:34] <Bonkycat> yes

[21:34] <Crystal2> yes

01[21:34] <@Spauwe> you have to kick an Al out to squeeze an Cr in

[21:34] <BrianQ> Yes

[21:34] <Dreamcatcher3> yes

[21:35] <BrianQ> and you look at every other atom (or its ion) that affects color and its size is such that it has to occupy the Al spot.

[21:35] <BrianQ> Fe, Mg, etc.

[21:35] <Doos> question

[21:35] <BrianQ> Yes, Doos

[21:36] <Doos> when the Al is substituted with Cr, is there a change in bond strength?

[21:37] <BrianQ> Yes, there are a lot of chemical changes, which for example is why one exhibits color and the other does not

[21:37] <Doos> ok, ty

[21:37] <BrianQ> We kind of leave that point until later, because we just want to see the mechanics of how to get a Cr into the Al spot... the diffusion process

[21:38] <Frankj> but the chromium would likely have joined the crystal during growth rather than by diffusion?

[21:38] <BrianQ> And for reference, those atoms in the middle of the periodic table, the transition metals, don't have much change in size when they go from atom to ion... so size on chart is fine.

[21:39] <BrianQ> Yes, true Frank.

[21:39] <BrianQ> That is a good point.

03[21:39] * Anon9778 (n=fn-javac@host81-157-111-180.range81-157.btcentralplus.com) has joined #gemology

[21:40] <BrianQ> But also notice the little atom that everyone has been talking about, Be, number 4

[21:40] <Bonkycat> that would then also be true for Iron and Titanium in nature yes?

[21:40] <Doos> about the same size as the transition elements

[21:40] <BrianQ> yes... and also though, Titanium has been diffused into sapphire

[21:40] <Bonkycat> yes

[21:41] <BrianQ> which was an early indicator of the world to come.

[21:41] <Frankj> question

[21:41] <BrianQ> yes, beryllium, though small in MASS, is just as large in VOLUME

[21:41] <BrianQ> yes Frank

[21:42] <Frankj> I always thought beryllium would have a smaller radius...along with the other so called light elements

[21:42] <BrianQ> Yep... surprise!

[21:42] <Frankj> to allow it to difuse

[21:42] <BrianQ> nope, you are trying to imagine a process that does not in fact take place...

[21:43] <Frankj> yes

[21:43] <BrianQ> We'll get there ;)

[21:43] <Frankj> ok I'll keep listening :)

[21:44] <BrianQ> Also another point, going back to Doos's question, the chemistry of Be in crystal is going to be very similar to what other transition element, as given away by its position in the periodic table?

[21:45] <BrianQ> in periodic table... atoms in same column exhibit similar chemistry.

[21:45] <Bonkycat> mg

[21:45] <BrianQ> yes, Be is going to do the same sort of things as Mg

[21:46] <BrianQ> which was already known as a color modifier.

02[21:46] * Anon9778 (n=fn-javac@host81-157-111-180.range81-157.btcentralplus.com) Quit ("Java user signed off")

[21:47] <BrianQ> Ok, now that we have some idea of the size of atoms, let's look at the different "classical" paths of diffusion...

02[21:48] * GemGuest22 (n=fn-javac@host69-53-127-106.birch.net) Quit ("Java user signed off")

[21:48] <BrianQ> If the atom or molecule to be diffused is very small, then there is the so called "interstitial" diffusion... the atom can move from small gap to small gap relatively easily.

[21:48] <BrianQ> For instance, take a look at number 2, He.

03[21:49] * GemGuest61 (n=fn-javac@host69-53-127-106.birch.net) has joined #gemology

[21:49] <BrianQ> oops, number 1, H

[21:49] <BrianQ> very small...

[21:50] <BrianQ> very easy to diffuse hydrogen into a mineral if the chemical conditions exist for it... not even too difficult to diffuse H₂O, because all three atoms are so small, they can fill the small gaps in crystals.

[21:50] <BrianQ> But the number of small atoms is *ahem* small, and their effect on color is *ahem* likewise small.

[21:51] <BrianQ> So this is not an important diffusion process for changing any gem's color.

[21:52] <BrianQ> To change color, usually you are going to have to swap one transition metal atom with another...

02[21:53] * GemGuest61 (n=fn-javac@host69-53-127-106.birch.net) Quit (Client Quit)

03[21:53] * GemGuest64 (n=fn-javac@host69-53-127-106.birch.net) has joined #gemology

[21:53] <BrianQ> This is called a "diffusive jump". Imagine you have a couple unit crystals, one with Cr at center and another with Al at center

03[21:54] * GemGuest64 is now known as javatest

[21:54] <BrianQ> There is some quantum mechanical probability that the Cr and Al will swap places.

[21:54] <BrianQ> And so, if you wait long enough, eventually they will swap places.

02[21:54] * javatest (n=fn-javac@host69-53-127-106.birch.net) Quit (Client Quit)

[21:55] <BrianQ> Can you picture this... the probability won't necessarily be very big, so it may take eons.

[21:55] <Doos> yesz

[21:55] <BrianQ> But eventually it will happen

01[21:55] <@Spauwe> I can imagin eit

[21:55] <BrianQ> This is the atomist picture of how diffusion occurs, this "swap" or "jump" process

[21:56] <BrianQ> And growing from two crystals to macroscopic size, this process is called "volume diffusion" or "lattice diffusion".

[21:56] <Bonkycat> question

[21:56] <BrianQ> The GIA chose the more catchy phrasing ;)

[21:57] <BrianQ> yes?

[21:57] <Bonkycat> when they swap places, does the surrounding O remain undisturbed?

[21:57] <BrianQ> yes, more or less... except their chemical environment has to adapt to the new center.

[21:59] <BrianQ> So the O's originally around the Cr, they now look just like the O's around the Al, since in fact they are surrounding an Al.

[22:00] <Frankj> this wouldn't cause a shift or change in colour though since there is still the same amount of chromium in the lattice?

[22:01] <BrianQ> Now, as mentioned, this probability even in the best case is low. As a result, if you lie a crysoberyl (sp?) on top a corundum, you may have to wait several millenia before any detectable migration of Be from the crysoberyl to the corundum.

[22:01] <BrianQ> Yes, Frank, exactly

[22:01] <BrianQ> So, how to increase the probability... add heat

[22:01] <BrianQ> Heat, as we've discussed previously is the movement, or vibrations, of atoms.

[22:02] <BrianQ> And by increasing that movement, increasing the motion of the Al and Cr around inside their individual crystals, you increase the probability that the two will "jump:

[22:03] <BrianQ> But there is a limit to heat... what is the heat limitation?

[22:03] <Frankj> melting point

[22:03] <Doos> melting point?

[22:03] <DragonStek> melting point

[22:03] <Doos> heh

[22:03] <BrianQ> yeppers...

01[22:03] <@Spauwe> look at frank with his slow connection!

[22:04] <BrianQ> you don't want to melt the stuff, or else you have to re-crystallize, and then you have a synthetic

[22:04] <Frankj> nanananana

[22:04] <BrianQ> heh!

[22:04] <BrianQ> Anyways, let's take a look at the volume diffusion animation I found, the lattice diffusion.

[22:04] <BrianQ> copy and paste into another window or tab:

[22:05] <BrianQ> <http://pvcdrom.pveducation.org/MANUFACT/SOLIDIFF.HTM>

[22:05] <BrianQ> Then click the start button

[22:05] <Doos> I don't have the plugin

[22:05] <Doos> but I'll be fine

[22:05] <BrianQ> :(

[22:05] <BrianQ> I'll explain what is showing...

02[22:06] * Bonkycat (n=fn-javac@pool-71-112-186-183.sttlwa.dsl-w.verizon.net) Quit (Read error: 104 (Connection reset by peer))

[22:06] <MoDo> I'm manually installing ... hold on!!

[22:06] <Crystal2> me too :(

[22:06] <DragonStek> ok me either

[22:06] <BrianQ> Egads... maybe have to try it offline after the chat...

[22:06] <Frankj> I don't have the plugin either...when I try to download it I cant bring the chat window up

[22:06] <MoDo> Rats! Didn't work :(

[22:07] <BrianQ> oks... y'all can try it after chat.

☺01[22:07] <@Spauwe> aaah, what a shame

[22:07] <DragonStek> ok saved it

[22:07] <Frankj> yes I'll down load it late and reread the chat while watching

☺01[22:07] <@Spauwe> such a nice site

[22:07] <MoDo> Will a copy of the chat be available later??

[22:07] <BrianQ> When things work, what you see is a bunch of red "gas" atoms bouncing around on top of white "crystal" atoms

[22:08] <BrianQ> hopefully MoDo, although I don't know how the magic happens

[22:08] <Doos> I can picture that

[22:08] <BrianQ> ...at room temp.

[22:08] <BrianQ> And never is one of the white atoms replaced by the red atoms... no jumps.

[22:08] <Frankj> I'll just leave the chat up on the desktop rather than wait for it to be posted

[22:08] <Dreamcatcher3> have to look later

[22:09] <BrianQ> but click a button, temp increases, and every so often a jump occurs..

[22:09] <BrianQ> so first you get a handfull of red atoms in the top layer, and over time there is a slow migration through the layers.

[22:10] <BrianQ> Always the top layers have the most red atoms.

[22:10] <MoDo> Question

[22:10] <BrianQ> Click the button a third time, and the source of red "gas" atoms is removed, and the temperature is raised.

[22:10] <BrianQ> um.. raised.

☺01[22:10] <@Spauwe> ghehe

03[22:11] * GemGuest84 (n=fn-javac@pool-71-112-186-183.sttlwa.dsl-w.verizon.net) has joined #gemology

[22:11] <BrianQ> and then the red atoms in the material end up getting spread uniformly through the white atoms as time goes on.

[22:11] <BrianQ> Sound familiar?

[22:11] <BrianQ> Doos, your question?

01[22:11] <@Spauwe> yes

[22:11] <Frankj> surface and then bulk diffusion

[22:11] <Doos> modo had a question

03[22:12] * GemGuest84 is now known as Bonkycat

[22:12] <Bonkycat> worm hole

[22:12] <MoDo> Is the jump made just by "vibration" or does the heat cause the crystal to expand and allow them to trade places?

[22:12] <BrianQ> um... it is all volume diffusion. The jump version

[22:12] <BrianQ> The "jump" is a quantum mechanical tunneling, more or less.

[22:13] <BrianQ> The "jump" is made much easier as heat increases the energy of the system... not that any of that is especially transparent

[22:13] <BrianQ> But I can give an analogy...

[22:13] <MoDo> Please do!

[22:14] <BrianQ> Imagine you are standing on a flat plane in front of a triangular hill, with a flat plane on the other side.

[22:14] <BrianQ> So how to get to the other side... ? Climb over the hill, of course.

[22:15] <BrianQ> But in quantum mechanics, you can also "tunnel" through the hill at no expense other than time (i.e., wait long enough, and eventually you are on the other side)

[22:15] <BrianQ> weird, but that is the way...

[22:16] <BrianQ> Now heat is energy, and in our picture energy raises you some height up the hill....

[22:16] <MoDo> Like a hot-air balloon?

[22:16] <Frankj> Brian does the fact of Be's low mass make a difference?...because copper is also the same size of radius...so will copper diffuse as easily as Be

[22:16] <BrianQ> But if you got to the top of the hill, everything would go kablooeey...

[22:16] <BrianQ> everything melts.

[22:16] <BrianQ> kind of like that MoDo...

[22:16] <Frankj> but the tunnel is shorter half way up the hill

[22:17] <BrianQ> The low mass does help... easier to make it rise up the hill.

[22:17] <BrianQ> And yes, that is the point Frank... higher up the hill, distance to tunnel is shorter...

[22:17] <MoDo> Ahhhh

[22:17] <BrianQ> so time is much less to end up on other side

[22:17] <Doos> sweet

[22:18] <BrianQ> But usually you need quite a lot of heat to significantly improve the "jumps".

[22:19] <BrianQ> Looking for a material to try volume diffusion (*ahem* lattice diffusion), what would be the first criterion?

[22:19] <BrianQ> high melting temperature!

👤02[22:19] * Frankj (n=fn-javac@84.4.68.228) Quit ("Java user signed off"👤)

👤01[22:19] <@Spauwe> aaah

👤03[22:19] * Frankj (n=fn-javac@84.4.68.228) has joined #gemology

👤01[22:19] <@Spauwe> aha

👤02[22:19] * Frankj (n=fn-javac@84.4.68.228) Quit (Client Quit👤)

👤01[22:19] <@Spauwe> ghehe

[22:19] <BrianQ> um... and so what typical gem mineral has high temp melt?

👤03[22:19] * Frankj (n=fn-javac@84.4.68.228) has joined #gemology

👤01[22:19] <@Spauwe> heh

[22:19] <BrianQ> corundum is a natural for this sort of exploration.

[22:20] <MoDo> Someone duct tape Frankj!

[22:20] <BrianQ> Next, an atom with a light mass is a good choice for diffusion. Looking at color chemistry...

[22:20] <Frankj> ok I've downloaded the plug in on another window but firefox did a restart and I've lost the chat up to now

👤01[22:21] <@Spauwe> missed nothing mate

[22:21] <BrianQ> and looking at periodic table... um.. chromium... nothing in its column has lighter mass...

[22:21] <BrianQ> looking at Fe... nothing in its column has lighter mass...

[22:22] <BrianQ> looking at Mg... aha!

[22:22] <Doos> Be

[22:23] <BrianQ> And so off you try... place a beryllium source in with corundum... raise temperature for 100 hours and see if anything happens.

[22:23] <BrianQ> raise close to melting point for best results.

[22:23] <Bonkycat> question-comment

[22:23] <BrianQ> oh look, I get a "rind" of beryllium around the stone.

[22:23] <BrianQ> yes?

[22:24] <Bonkycat> In Ted's book on BE, he states he can get the Be into corundum at much lower temps, just takes longer. Any special reason for that/

01[22:24] <@Spauwe> longer tunnel Bonkey

[22:24] <Bonkycat> ahhh

[22:24] <DragonStek> where it is on the hill

[22:24] <Bonkycat> thanks

[22:24] <DragonStek> opps

[22:24] <Doos> same as no extra temp .. chrysoberyl on top of corundum

[22:24] <BrianQ> yes, exactly... much lower temperatures reduces probability of jump, so just have to wait longer for same effect.

[22:25] <Frankj> If we used colourless corundum and a chromium source then we could theoretically produce ruby...why doesn't anyone do this?...doesn't it work?

[22:25] <BrianQ> um... here it is probably because it is not easy to raise the chromium up the hill...

[22:26] <BrianQ> Similar with magnesium....

[22:26] <Frankj> too much mass?

[22:26] <BrianQ> Yes

01[22:26] <@Spauwe> too much costs involved with the extra heating

01[22:26] <@Spauwe> gas is pricey, so is elec

[22:26] <MoDo> Okay, Brian ... You have two hours to apply this to the tourmaline situation :)

[22:26] <BrianQ> Hah! We've barely started.

[22:27] <MoDo> The Steelers play at 5:30 ;)

[22:27] <Frankj> Modo these lectures usually take weeks

[22:27] <BrianQ> heh!

[22:27] <BrianQ> yep, we have to shut down before two hours anyways ;)

[22:28] <MoDo> Okay, I'm "reading" patiently :)

[22:28] <Bonkycat> Tough instructor, no potty breaks :)

[22:28] <MoDo> LOL

[22:28] <Crystal2> LOL

[22:28] <BrianQ> Anyways, here is the deal that all of you realize... every possible attempt will be made to diffuse a color-change atom into a mineral.

[22:28] <Dreamcatcher3> LOL

[22:29] <MoDo> Yes

[22:30] <BrianQ> the corundum Be case is an interesting detective story to me, but has so many bad consequences for gemologists.

[22:30] <BrianQ> But the situation could have been worse.

[22:31] <BrianQ> If it were found that Mg could be diffused in a timely manner, then there would have been no smoking gun signature.

[22:31] <BrianQ> Since Mg is a well-known naturally occurring chromophore.

[22:32] <BrianQ> We can take a potty break now, and I'll lead on to this particular story and finish up the other diffusion methods.

☺01[22:32] <@Spauwe> righto

[22:33] <Dreamcatcher3> Run!!!!!!!!!!!!!!

[22:33] <Doos> ciggy break Spauwe??

☺01[22:33] <@Spauwe> nah quit

[22:33] <Bonkycat> Just did that

[22:33] <Doos> that is twice this week Spauwe

☺01[22:33] <@Spauwe> bought and smoked one package...

[22:34] <Doos> one day you are 80 and need a male nurse to whipe your bottom

01[22:34] <@Spauwe> ghehehe

[22:34] <Doos> you'd wished you kept smoking

01[22:34] <@Spauwe> I hope so, I hope so

[22:35] <MoDo> During the pause, would anyone care to list the "well-known" chromophores for me??

01[22:36] <@Spauwe> that entire third row expept for the two outer ones on each side

[22:36] <Frankj> it's the transition element Modo 22 to 29 are the main ones

[22:36] <Bonkycat> Sorry looking at the densities of these elements in gems, anyone else have that book handy?

[22:36] <MoDo> Okay, thanks!

[22:37] <Doos> still there DragonStek?

[22:37] <Frankj> which book Bonkycat

[22:37] <Bonkycat> gems, sixth edition

[22:37] <Doos> gems by webster proolly

[22:37] <Bonkycat> yes

[22:37] <DragonStek> titanium, vanadium, chromium manganese iron cobalt nickel copper

[22:38] <DragonStek> hehe yeah

[22:38] <Doos> ~baby we were born to run~

[22:39] <MoDo> Thanks, DragonStek! I couldn't tell if it was Ni or NI LOL

[22:39] <BrianQ> ok, I'm back

[22:39] <DragonStek> no problem , your welcome

[22:39] <Bonkycat> Be looks to be much more dense than Mg, unless the images are not showing the elements relative to each other

[22:39] <BrianQ> ok, now the GIA article reads like a great detective story

[22:39] <BrianQ> http://www.rpi.edu/~watsoe/research/Watson&Baxter_EPSL07.pdf

[22:39] <Doos> its the atomic radii that are pictured

[22:40] <BrianQ> and hindsight is always 20/20

[22:41] <MoDo> This is really helping me, Brian! Thanks for dumbing it down :P

[22:41] <BrianQ> So that now we can see why the Be-corundum situation looks almost inevitable

☒02[22:41] * Gloribell (n=fn-javac@ip24-254-173-81.rn.hr.cox.net) Quit ("Java user signed off"☒)

☒03[22:41] * Gloribell (n=fn-javac@ip24-254-173-81.rn.hr.cox.net) has joined #gemology

[22:41] <Bonkycat> Need lots more time to read all that

[22:42] <Doos> ok, read the article BrianQ, interesting

☒01[22:42] <@Spauwe> ghehe

[22:42] <Doos> ;)

[22:42] <BrianQ> First point that hurt the average gemologist is when the cost of heat-treated corundum was only discounted slightly from unheated gems

[22:43] <BrianQ> This set up the anything-goes situation. The ordinary gemologist (as JB refers to them) has the tools to detect heat treatment.

[22:43] <BrianQ> If the heat-treated corundum was held in low regard, then nothing would have progressed.

[22:44] <Dreamcatcher3> all comes down to money

[22:44] <BrianQ> The second point was the demonstration in the 60s that titanium could be volume diffused into corundum

[22:44] <BrianQ> yes Dreamcatcher, exactly

[22:45] <BrianQ> This should have been a big red flag... but the market continued to tolerate heat treatment so as to sell more rubies and such

[22:45] <Doos> or to meet demand

[22:45] <BrianQ> yes...

[22:46] <BrianQ> In my mind, the true question is why did it take so long to develop the Be diffusion...

[22:46] <Frankj> I think most retailers were stuck with huge amounts of stock before they caught on it was heated

[22:46] <DragonStek> i thought it was by accident

[22:46] <BrianQ> If I had been a researcher interested in this process, I would have been trying to diffuse everything!

[22:47] <Doos> true BrianQ, good money to be made

[22:47] <Frankj> I understood it was discovered by accident when chrysoberyls were mixed in with sapphires by mistake in the heating process

[22:47] <DragonStek> hehe true

[22:47] <BrianQ> And beryllium would have been at the top of my list, low mass... act like Mg

[22:47] <Doos> but I think most researchers already have well paid jobs

[22:47] <BrianQ> heh...

[22:47] <BrianQ> yes, but they are always looking for new processes...

[22:48] <BrianQ> and the corundum chromophores have been of interest to industry for a long time in the synthetics

03[22:48] * GemGuest94 (n=fn-javac@cpc1-nwrk3-0-0-cust711.nott.cable.ntl.com) has joined #gemology

[22:48] <BrianQ> I would have tried Be and Mg next, for sure

02[22:48] * GemGuest94 (n=fn-javac@cpc1-nwrk3-0-0-cust711.nott.cable.ntl.com) Quit (Client Quit)

[22:49] <BrianQ> very strange it took so long...

02[22:49] * Frankj (n=fn-javac@84.4.68.228) Quit (Read error: 104 (Connection reset by peer))

[22:49] <Doos> we now have iron and manganese is tourmaline ;)

[22:49] <BrianQ> but obviously no one was studying diffusion in corundum after the 60s... so it came about by accident

[22:49] <BrianQ> yes, we'll get there...

[22:49] <Doos> in*

[22:49] <Doos> that will be the first book I buy

[22:50] <MoDo> LOL

[22:50] <BrianQ> Here is the thing... it is apparent that the Be was discovered by accident simultaneously by several individuals.

[22:51] <BrianQ> Their discoveries enabled them to sell quite quickly, so they didn't follow due diligence in researching the process.

[22:52] <BrianQ> The first clue to the labs was the coloring formed a "rind".

03[22:52] * Anon5192 (n=fn-javac@84.4.68.228) has joined #gemology

[22:52] <Anon5192> so who am I now

[22:52] <Anon5192> ah

[22:52] <BrianQ> This could have been avoided if the burners had done a little research and found out how to create uniform distribution.

[22:52] <BrianQ> Thus delaying detection for a good while longer.

03[22:52] * Anon5192 is now known as Frankt

[22:53] <BrianQ> As time went on, there did turn out more examples of uniform coloring, but by then the detectives had the scent.

[22:53] <Frankt> what did I miss?

[22:54] <Doos> I'll paste it to you Frankt

[22:54] <Doos> hi

[22:54] <Frankt> ty

[22:54] <BrianQ> um... just looking at things with 20/20 hindsight.

[22:54] <BrianQ> pretty naughty, I guess.

[22:54] <Frankt> can you include the pdf link...it froze me up last time

[22:55] <BrianQ> So the whole thing was really de-centralized, with no quality control, which provided clues that the heavy instruments had to be used to analyze the properties.

[22:56] <BrianQ> Once you note with your heavy instrumentation that Beryllium seems to appear with the color...

[22:56] <BrianQ> the labs have to reproduce the results... and they did.

[22:57] <BrianQ> case closed. Except now the average gemologist doesn't have the tools to identify a uniformly Be-treated corundum definitively...

[22:57] <BrianQ> so it has to be sent to lab for them to train their heavy instruments on for verification.

[22:59] <BrianQ> That is pretty much it for the Be-corundum story.

[22:59] <Doos> yes

[23:00] <MoDo> Interesting!

[23:00] <DragonStek> thanks brian , understand it better now

[23:00] <BrianQ> Now this diffusion process is called "volume diffusion" or "lattice diffusion" and geologically takes millions of years

[23:00] <Dreamcatcher3> thanks Brain

[23:00] <BrianQ> Adding enough heat can reduce it to hundreds of hours.

[23:00] <BrianQ> But it is what the geologists call a slow process...

[23:01] <BrianQ> Can tourmaline be "colored" using this process? Ummm... what is the melting point of tourmaline?

[23:01] <BrianQ> Isn't it one of the minerals last out of solution?

[23:02] <Bonkycat> 700C

01[23:02] <@Spauwe> about 800 - 900 celcius I think

[23:02] <BrianQ> And compared to corundum, what is its melting point?

[23:02] <Doos> 2100?

01[23:02] <@Spauwe> 2100

[23:02] <Frankt> 2000 c

01[23:02] <@Spauwe> ghe

01[23:02] <@Spauwe> somewhere around those values

[23:02] <Frankt> ok I'm outvoted

[23:02] <BrianQ> Ok, so my guess is no one is going to use "volume diffusion" on tourmaline.

01[23:03] <@Spauwe> question

[23:03] <Doos> to risky?

[23:03] <Bonkycat> although when ted speaks of BE diffusion in sapphire he notes cases of 1625C for 6 hours to get results.

[23:03] <Dreamcatcher3> they can use less heat and more time

[23:03] <BrianQ> Yes, but 1625 and 900 C are still worlds apart

[23:03] <Bonkycat> what would happen if we added pressure?

[23:03] <BrianQ> and that is getting right up against the tourmaline melting point.

[23:04] <Doos> everyone seems to agree that it is not very plausible

[23:04] <BrianQ> in solid, pressure is not going to do much, and very few furnaces are equipped to regulate pressure.

[23:04] <MoDo> Isn't RJ's report about shoving iron and manganese into hollow tubes in tourmaline?

[23:05] <Bonkycat> I am afraid that I will be the odd duck, as I not only believe it is plausible, but it is happening

[23:05] <BrianQ> But... and this is what you are mentioning MoDo...

[23:05] <Frankt> so if diffusing Be is unlikely then copper diffusion would be even more difficult?

[23:05] <Doos> we'll see Bonkycat

[23:05] <Bonkycat> agreed Alain

[23:05] <BrianQ> there are a set of diffusion processes which fall under the category "fast diffusion processes".

[23:05] <Doos> he lies about everything so why not now again

[23:06] <Frankt> I just think there are lots of sneaky bastards in the world and if it can be done then it will be

01[23:06] <@Spauwe> no going there there and now

[23:06] <BrianQ> tut tut, let's explore to make sure we know what we are talking about!

[23:06] <Bonkycat> I came to learn, lets keep our fighting for another day

[23:06] <BrianQ> I'm thinking the "slow" volume diffusion isn't applicable for tourmaline, but we have to examine the fast processes.

[23:07] <Dreamcatcher3> Brian please go on

[23:07] <BrianQ> which is what led to the um... what is that iron thingy mineral...

[23:07] <Doos> hematite?

[23:07] <BrianQ> heh, the stone that must not be mentioned ;)

[23:08] <Doos> andesine?

[23:08] <BrianQ> yep, whatever it is.

[23:08] <Dreamcatcher3> it was a money maker

[23:08] <BrianQ> Which is again, why it happens.

[23:09] <Bonkycat> and a melt point at 1250, getting warmer (or cooler)

[23:10] <Doos> it was not bulk diffused

[23:10] <Doos> that myth was busted

[23:10] <BrianQ> Now... the first and probably only important geologically "fast diffusion process" is called "grain boundary diffusion"

[23:10] <BrianQ> although I guess the gem labs prefer the term "pipe diffusion"?

[23:10] <Doos> yes

[23:11] <BrianQ> And this is quite different from the volume diffusion.

[23:11] <BrianQ> Now I mentioned at the beginning the Czochralski method for growing single macroscopic crystals of material

[23:11] <BrianQ> from an initial seed crystal.

[23:12] <Doos> ah full circle again

[23:12] <BrianQ> why of course, science is a quilt, with each strand linked and tied.

[23:13] <BrianQ> We are the un-weavers, trying to pull out each strand :)

[23:13] <BrianQ> but keep tugging something else loose.

[23:13] <MoDo> Hmmm ... more a tapestry than a quilt, then.

[23:14] <Dreamcatcher3> could they have found a strand that we didn't see yet?

[23:14] <BrianQ> Of course.

[23:14] <BrianQ> Now in nature, crystals form from many separate seeds, and these crystals grow and run into each other.

[23:15] <BrianQ> Not only in nature, in steel production and in most solid production.

[23:15] <BrianQ> Let me give you an example of this that is NOT gem-based. We have all seen bar magnets and iron rods.

[23:16] <Dreamcatcher3> yes

[23:16] <Bonkycat> phone, will catch up, just don't ask me anything for a few minutes :)

[23:16] <BrianQ> The separate crystals in these materials are called "domains", and each domain acts like its own microscopic magnet

[23:16] <Doos> all well Bonkycat?

[23:17] <BrianQ> Here is a page with a nice picture of these microscopic domains:

[23:17] <BrianQ> http://en.wikipedia.org/wiki/Magnetic_domains

01[23:18] <@Spauwe> yep cool

[23:18] <MoDo> Nice!

[23:18] <BrianQ> each domain grew from a seed until it ran into its neighboring domain.

[23:19] <BrianQ> As mentioned, each domain is its own little magnet, with a North and South (N&S) pole

[23:19] <BrianQ> Usually in something like magnetic steel, the direction along which these N&S poles lie...

[23:19] <BrianQ> these directions in each domain are random.

🕒02[23:20] * Dreamcatcher3 (n=fn-javac@ool-182f106c.dyn.optonline.net) Quit ("Java user signed off"🕒)

[23:20] <BrianQ> As a result, in bulk, the material doesn't act like a magnet.

[23:20] <BrianQ> even though each domain is a magnet.

[23:21] <BrianQ> So a steel rod doesn't pick up a paperclip, even though both are composed of microscopic magnets

[23:21] <BrianQ> But, put the steel rod next to a magnet, and all those microscopic domains will align themselves with the external magnet.

[23:21] <BrianQ> And the steel rod becomes a magnet in bulk.

[23:21] <MoDo> MRI

🕒03[23:21] * Dreamcatcher3 (n=fn-javac@ool-182f106c.dyn.optonline.net) has joined #gemology

[23:22] <BrianQ> MRI... a little different story... here, just figuring out why a steel rod doesn't pick up a paperclip, but a steel rod held next to a magnet does pick up a paperclip :)

[23:23] <BrianQ> The bottom line is that magnetic effects arise from all these little domains, little crystals that grew into each other.

[23:24] <Dreamcatcher3> they are thinking out side the box of nature, maybe we should too

[23:24] <BrianQ> The crystals that make up gems evolved similarly, there are microscopic crystals that could be called domains, but aren't

[23:25] <BrianQ> as opposed to the single crystal that makes up a silicon boule used for microchips. There is only one "domain" and that is the whole thing.

[23:26] <BrianQ> Anyways, as these microscopic crystals grow into each other, they do not link up perfectly at their boundary.

[23:26] <BrianQ> If they did link up perfectly, then two "crystals" would become one.

[23:27] <BrianQ> So the unit cells at the boundary due to one crystal is tilted or whatever, compared to the unit cells due to the other crystal.

[23:27] <BrianQ> Following this?

[23:27] <Doos> yes

[23:27] <Frankt> yes

[23:27] <DragonStek> yes

🕒01[23:27] <@Spauwe> no

🕒01[23:27] <@Spauwe> ghehe

[23:27] <MoDo> Sort of

[23:28] <Dreamcatcher3> yes

[23:28] <Crystal2> I think so

[23:28] <BrianQ> heh, but to try reduce confusion, think of crystals as being composed of wooden blocks...

[23:29] <BrianQ> the wooden blocks are the unit cells. Stack one block next to the other and the crystal grows.

[23:29] <BrianQ> But now you start another crystal nearby, with its first unit cell (its first block) at an angle with respect to those of the first crystal.

[23:30] <BrianQ> As you stack blocks in the second crystal, eventually meeting up with the first crystal, the blocks are going to meet at an angle, so there are little triangular gaps between the two crystals.

[23:30] <BrianQ> Any help?

[23:31] <Bonkycat> yes

[23:31] <Doos> twinning

[23:31] <MoDo> Yep, thanks

[23:31] <DragonStek> like a twin of the crystal growing

👤1[23:31] <@Spauwe> this is what we call polysynthetic twinning aka lamellar twinning?

[23:31] <Dreamcatcher3> yes

[23:31] <DragonStek> opps

[23:31] <BrianQ> heck, I don't know what ya call it :)

[23:31] <MoDo> LOL

[23:31] <Crystal2> yes

👤1[23:31] <@Spauwe> probably not

👤1[23:32] <@Spauwe> the above is only applicable when it occurs in thin parallel layers

[23:32] <BrianQ> But it produces microscopic uniformly oriented crystals, bumping into each other at different orientations

👤1[23:33] <@Spauwe> so that we get a polycrystalline substance...?

[23:33] <BrianQ> The important thing is that there are gaps, wide open spots all along the boundary of the two crystals.

[23:33] <BrianQ> mm, I can't guarantee, because I'm not so familiar with the names.

[23:33] <Bonkycat> similar to the diamonds we subject to hightemp/pressure to correct?

[23:33] <BrianQ> yes, that is more the way.

[23:34] <Dreamcatcher3> and what if you added something along the way?

01[23:34] <@Spauwe> a single crystal like a quartz crystal isn't made up of your 'wooden blocks' now is it?

01[23:34] <@Spauwe> HPHT treatment of diamond is used to fix lattice defects

[23:34] <Bonkycat> So, in theory, you are suggesting that in this circumstance there would be more opportunity to "put something" in there?

01[23:35] <@Spauwe> crooked atomic structures

[23:35] <BrianQ> Now the idea is that "grain boundary diffusion" takes advantage of these gaps, it is easier for impurities to fill these gaps than for the impurities to "volume diffuse" jump from one unit cell to another.

[23:35] <Frankt> well parting is caused by weak spots where twinned crystals meet

[23:36] <BrianQ> So maybe we are saying the same thing Lisa

[23:36] <Bonkycat> I think so Brian

01[23:36] <@Spauwe> we are all talking different stuff here, Brian I think you have us bushed

[23:36] <BrianQ> heh, yep, it has been long.

01[23:36] <@Spauwe> nono

[23:36] <Bonkycat> What if we were to subject the crystal to a process that caused these gaps?

[23:36] <MoDo> And we still haven't talked about tourmaline!

[23:36] <BrianQ> maybe we should pick this up next Sunday?

[23:36] <Dreamcatcher3> no

01[23:37] <@Spauwe> no

01[23:37] <@Spauwe> just get this clear

[23:37] <BrianQ> You want to continue?

[23:37] <Bonkycat> I would if you are willing

[23:37] <MoDo> You have another hour

[23:37] <BrianQ> now?

[23:37] <DragonStek> yes if you can

[23:37] <Dreamcatcher3> this is getting good, thinking out side the box

[23:37] <Gloribell> continue

[23:37] <BrianQ> ok, back to our picture of the magnetic domains...

01[23:37] <@Spauwe> are you saying that a single crystal like a corundum crystal or whatever is made up out of 'domains'?

[23:38] <BrianQ> you can tell looking at the picture there are different little areas. (yes Tim)

[23:38] <Crystal2> need to put duckies up for the night; will be back as soon as I can :)

[23:38] <BrianQ> Now, look at the average bar of steel, can you see those little domains, even under 10x loupe?

[23:38] <BrianQ> ok Crystal.

[23:39] <Frankt> no but a bar of steel is not a crystal

[23:39] <BrianQ> um, yes it is Frank :)

[23:39] <Frankt> there are no regular repeating atomic bonds like a crystal is supposed to have by definition

[23:39] <BrianQ> it just happens to not be a transparent crystal.

[23:39] <BrianQ> oh, yes, there is regular repeating atomic bonds, for sure!

[23:40] <Frankt> but it is melted and then cooled too quickly to properly crystallise

01[23:40] <@Spauwe> in every domain... but not throughout...

[23:40] <Frankt> it must be amorphous

[23:40] <BrianQ> no, it is sets of microcrystals

[23:41] <Frankt> ok so it's polycrystalline

01[23:41] <@Spauwe> ok... so a microcrystalline substance

01[23:41] <@Spauwe> indeed frank

01[23:41] <@Spauwe> lik jade, chalcedony, or opal

01[23:41] <@Spauwe> no Brian?

[23:41] <BrianQ> still a crystal material, yes and like those

01[23:41] <@Spauwe> aaaaaah

[23:41] <Frankt> ok

01[23:41] <@Spauwe> ok

01[23:41] <@Spauwe> phew

01[23:42] <@Spauwe> so not like sapphire, tourmaline and labradorite...

[23:42] <BrianQ> anyways, those boundaries become distinct because of the slight disorientation between adjacent crystals.

[23:43] <BrianQ> um... not quite, because there is still ways to dislocate crystals in those materials.

[23:43] <Bonkycat> irradiation?

[23:43] <BrianQ> no... I mean naturally...

[23:44] <Doos> BrianQ, early day tomorrow .. I have to excuse myself

[23:44] <BrianQ> A piece of corundum rough is not a pure single crystal, defects and all sorts of things disrupt alignment

[23:44] <BrianQ> ciao Doos

[23:44] <Doos> thanks for the great lesson (again)

[23:44] <DragonStek> night sweety

[23:44] <Bonkycat> night Alain

[23:44] <Doos> night darlinks

01[23:44] <@Spauwe> bye doosie

[23:44] <Frankt> night doos

[23:44] <MoDo> Night Doos

02[23:45] * Doos (n=doos@84.31.163.77) Quit ("Leaving")

[23:45] <Frankt> question

[23:45] <Dreamcatcher3> night Alain

[23:45] <BrianQ> So... you get mis-alignments of microscopic crystals, even though they are all the same material.

[23:45] <Frankt> If I have a perfect completely clean well formed crystal (say beryl) with perfect habit etc isn't it all one domain?

[23:46] <BrianQ> In nature it doesn't happen that way... um what would be the color of a perfect beryl?

01[23:47] <@Spauwe> clear

[23:47] <Frankt> colourless

01[23:47] <@Spauwe> beryllium aluminium silicate

[23:47] <BrianQ> but most beryl of interest are colored, yes, by impurities which is going to dislocate regions, causing boundaries... mismatches in orientation.

[23:48] <Bonkycat> yes

[23:48] <Frankt> yes

[23:48] <Dreamcatcher3> yes

01[23:48] <@Spauwe> yes, but different then all different domains due to different 'seeds'

[23:48] <Bonkycat> impurities that are larger and denser than the make up, like vanadium

[23:49] <Dreamcatcher3> impurities from one spot could change everything

[23:49] <BrianQ> yes, so not a single perfect crystal, I don't think. These "boundaries" exist throughout the gem material.

[23:50] <Dreamcatcher3> something the other beryls don't have

[23:50] <BrianQ> And the thing is, they have empty space in them that isn't in a set of aligned unit cells.

[23:51] <Frankt> ok lets accept that and move on...without these defect in the lattice the quick diffusion won't work anyway

[23:52] <Dreamcatcher3> location location location

[23:52] <Frankt> lol

[23:52] <BrianQ> yep!

[23:52] <Bonkycat> In nature, what would be the causes of the defects?

[23:53] <MoDo> *heavy sigh*

[23:53] <BrianQ> impurities, growth from different seeds, the usual stuff.

[23:53] <Frankt> growth tubes, healed fractures, twinning?

[23:53] <Frankt> etc

[23:55] <BrianQ> But these boundaries tend to be connected and extend throughout the material of interest. So if an atom, say, can find its way into one particular boundary gap, it should be able to move relatively freely to any other boundary gap.

[23:55] <MoDo> Makes sense

[23:56] <BrianQ> This is the so-called "grain boundary diffusion" which the gem labs are calling pipe diffusion.

[23:57] <MoDo> Ahhhh

01[23:57] <@Spauwe> which can only take place through defect in the crystal structure...

[23:57] <Dreamcatcher3> or location

[23:58] <BrianQ> One could sort of think of it, I guess, as little "pipes" or "veins" throughout the gem, and pour "water" into the top of the "pipe" or pour "blood" into the top of the "vein", it will fill throughout the material.

[23:58] <Dreamcatcher3> never say always, and never say never

[23:58] <BrianQ> Yes, Spauwe, about the defect.

[23:58] <Frankt> would this allow the diffusion of heavier elements as long as their radius fitted into the gaps

[23:59] <BrianQ> Frank, the chemical environment would have to be just so in order to allow a given type atom in...

[23:59] <BrianQ> But the space is there, and once the atom is allowed to enter, it can go anywhere.

Session Time: Mon Jan 19 00:00:02 2009

[00:00] <Frankt> so its valency is still important?

[00:00] <Frankt> or is there no chemical bonding?

[00:01] <BrianQ> Yes, the whole chemical nature is still important. Not any atom is going to be able to follow this "grain boundary diffusion".

[00:01] <Frankt> ok

[00:01] <MoDo> Can this "pipe diffusion" be artificially induced in order to introduce chemicals?

[00:02] <MoDo> Okay, that question didn't come out right.

[00:02] <BrianQ> But if the "grain-boundary" IS an allowed pathway, then it will be a FASTER diffusion pathway than "volume".

[00:02] <BrianQ> The short answer, MoDo, is I don't think so, no.

[00:03] <Bonkycat> Not even with irradiation Brian?

[00:04] <BrianQ> It is hard to envision irradiation creating defects that form spiderweb paths through the material, but I won't rule it out.

[00:04] <Bonkycat> What if I showed you an image of just that

[00:05] <Frankt> what about quench crackled stones

[00:05] <Bonkycat> spiderweb paths

[00:05] <BrianQ> Let's finish the topic of the pathway first!

[00:05] <MoDo> Yes, please!

[00:05] <BrianQ> We can evaluate ways maybe later.

[00:05] <Bonkycat> excellent, you are a fantastic teacher!

[00:06] <MoDo> I'm still waiting to find out if iron and manganese (or is it magnesium?) can be diffused into tourmaline.

[00:06] <BrianQ> At this point, you might be able to convince me fairies are sitting on my shoulder.

🔗03[00:06] * ISG (n=fn-javac@adsl-75-36-234-55.dsl.pltn13.sbcglobal.net) has joined #gemology

[00:06] <Dreamcatcher3> I think the chemical nature of location irradiation could work in some, but not all locations

[00:06] <MoDo> Hi ISG

🔗01[00:06] <@Spauwe> ghehe

[00:06] <Frankt> Hi ***ISG

🔗01[00:06] <@Spauwe> ISG ey

🔗01[00:06] <@Spauwe> welcome

🔗01[00:06] <@Spauwe> a wee bit late

[00:07] <ISG> Sorry... didn't get the message about the chat until just now.

🔗01[00:07] <@Spauwe> Lisa will fill you in

[00:07] <ISG> I'm Nancie_Gemnut... but not registered on this site

[00:07] <Bonkycat> If that is indeed Robert

🔗01[00:07] <@Spauwe> and there will be a log posted somewhere oncoming week

[00:07] <Dreamcatcher3> Hi ISG

[00:08] <BrianQ> Now geologically, the "grain boundary diffusion" is referred to as a fast diffusion because it takes maybe only a thousand years, rather than the million years of "volume" diffusion

[00:08] <Bonkycat> LOL, much shorter

[00:09] <BrianQ> Yep, just as with the volume diffusion, how can we speed up the grain boundary diffusion?

🔗03[00:09] * ISG is now known as Nancie_Gemnut

[00:09] <MoDo> I guess there are no eye-witnesses! :p

[00:09] <Bonkycat> heat

[00:09] <BrianQ> yep, heat.

[00:10] <Crystal2> I'm back :)

[00:10] <Dreamcatcher3> heat

[00:10] <BrianQ> only, we don't need nearly the amount of heat required for volume diffusion.

[00:10] <MoDo> Ducks all in a row, Crystal2?

[00:10] <Bonkycat> wb crystal, read back and catch up

[00:10] <Crystal2> yep :p

[00:10] <Bonkycat> interesting Brian, is that because the "tunnel" is "pre-dug"?

[00:11] <BrianQ> Yes, kind of pre-dug for a certain kind of atom along a certain path.

[00:12] <BrianQ> Diffusion of this sort doesn't really penetrate into the actual microscopic crystals, it fills in around the boundaries of these crystals, but as such, it appears uniform throughout the stone.

[00:12] <BrianQ> Just like blood cells don't migrate into my skin cells, but poke my skin anywhere and I am going to bleed.

[00:13] <BrianQ> Maybe that is a good analogy, maybe not.

01[00:13] <@Spauwe> I like it

[00:13] <Frankt> and this is what was done with the andesine?

[00:13] <DragonStek> good

[00:13] <Dreamcatcher3> works for me

[00:13] <BrianQ> Yes, indeed, Frank. This is the thing that was determined...

01[00:13] <@Spauwe> according to Emmett...

[00:14] <BrianQ> yes, to Emmett...

[00:14] <BrianQ> <http://www.jckonline.com/article/CA6613857.html>

[00:14] <MoDo> 15 minutes left!

01[00:14] <@Spauwe> here the 'boudaries' were along the deformations between layers of different orientated feldspar structures

[00:15] <BrianQ> The jist is this, the andesine had a natural "grain diffusion path" for copper...

[00:15] <Bonkycat> yes

[00:15] <Dreamcatcher3> yes

[00:16] <BrianQ> So this is how the copper entered Oregon material naturally...

[00:16] <Frankt> only copper could have entered?

[00:16] <Bonkycat> not sure, it tends to concentrate to the centers of Oregon material, so with my limited knowledge of formation, I would say no

[00:17] <Frankt> remember that with the oregon material it happened over a much longer period than with the lab diffused

[00:17] <Bonkycat> so over time, would naturally concentrate to the center of the crystal

[00:18] <BrianQ> I don't know Frank if copper is the only thing... and yes, with oregon material nature takes 1000 years...

[00:18] <BrianQ> whereas with man-made diffusion, maybe takes 100-1000 hours.

[00:18] <MoDo> For those interested: The Arizona Cardinals are going to the Super Bowl.

[00:18] <Nancie_Gemnut> So the difference is 1000 years vs. 90 days?

[00:18] <Frankt> maybe lisa perhaps as the outside of the crystal cooled the copper migrated to the centre???

[00:18] <BrianQ> Yes, that is the difference.

[00:18] <Bonkycat> I was thinking that Frank!!

[00:19] <Frankt> modo were waiting till you go watch the footbal before we start on tourmaline

[00:19] <Bonkycat> Trying to play it out in my hea

[00:19] <Bonkycat> *d

[00:19] <MoDo> I thought so!!! LOL

[00:19] <BrianQ> I do have to call it quits for now... but I'm willing to take up the subject again next Sunday.

[00:19] <BrianQ> If anyone wants to...

01[00:19] <@Spauwe> deal

[00:19] <Bonkycat> Would love to

[00:19] <Bonkycat> count me in

[00:19] <DragonStek> yes thanks brian

[00:19] <Gloribell> Count me in

[00:19] <Frankt> Ok thanks Brian another fine lesson...see you next week

[00:19] <DragonStek> great info

[00:19] <MoDo> Thanks for your time and intelligence, Brian!

[00:20] <MoDo> Everyone go root on the Steelers now!!!

[00:20] <Gloribell> Brian just a great lesson, I learned a lot.

[00:20] <Bonkycat> Thanks for the hospitality

[00:20] <BrianQ> and MoDo, as for tourmaline.... maybe we can suppose some things next time.

[00:20] <Bonkycat> I too learnd much

[00:20] <Nancie_Gemnut> Thanks Brian... I'll look forward to seeing the entire "chat" posted later

[00:20] <Dreamcatcher3> thank you Brain

[00:20] <MoDo> Okay ... I'll be here!!

[00:20] <BrianQ> ciao everyone, y'all welcome

01[00:20] <@Spauwe> ISG-ers can pay \$50,- at the door, thanks for coming and hope to see y'all again

01[00:20] <@Spauwe> ghehehe

[00:20] <Crystal2> Fantastic lesson, as always, Brian. You have a way of explaining things we can understand

[00:20] <Gloribell> Goodnight all

[00:20] <Crystal2> LOL

02[00:20] * BrianQ (n=fn-javac@adsl-230-4-218.hsv.bellsouth.net) Quit ("Java user signed off"⁰²)