IDDP-2 Core Descriptions and Graphic Logs

Logged by R. A. Zierenberg and the on-site IDDP-2 geologic team

Core Run 3: 3648.00 to 3648.52 m (0.52 m) and loose fill (fragments A through K)

Core Run 4: 3649.80 to 3649.805 m (0.005 m)

Core Run 5: 3865.50 to 3869.35 m (3.85 m) and loose fill (fragments A through N)

Core Run 6: 3869.80 to 3869.95 m (0.15 m) and loose fill (fragments A through O)

Core Run 7: 4090.00 to 4090.12 m (0.12 m) and loose fill (fragments A through M + additional fragments)

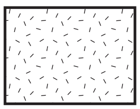
Core Run 8: 4254.60 to 4254.88 m (0.28 m) and loose fill (fragments A through H)

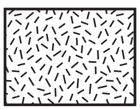
Core Run 10: 4309.90 to 4310.12 m (0.22 m)

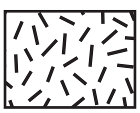
Core Run 11: 4634.20 to 4641.78 m (7.58 m)

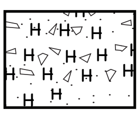
Core Run 12: 4642.80 to 4651.80 m (9.00 m)

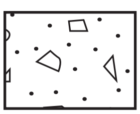
Core Run 13: 4652.00 to 4657.58 m (5.58 m)

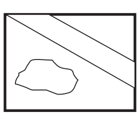

Fine Grained Basalt (<0.25 mm)

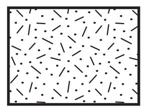

Medium Grained Basalt (0.25 < 2 mm) with a Doleritic/Ophitic Texture

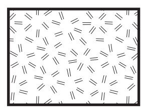

Coarse Grained Basalt (> 2 mm) with a Doleritic/Ophitic Texture

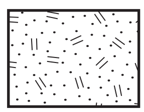

Hyaloclastite

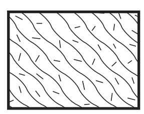

Hyaloclastite Sandstone/Siltstone

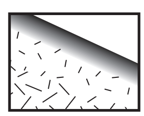

Pl-rich Plagiogranite Veins/ Segregations

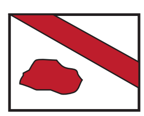

Medium Grained Glomeroporphyritic Basalt Intrusive


Two-pyroxene diabase with a Heterogeneous Texture


Mafic Intrusive with a Heterogeneous Texture

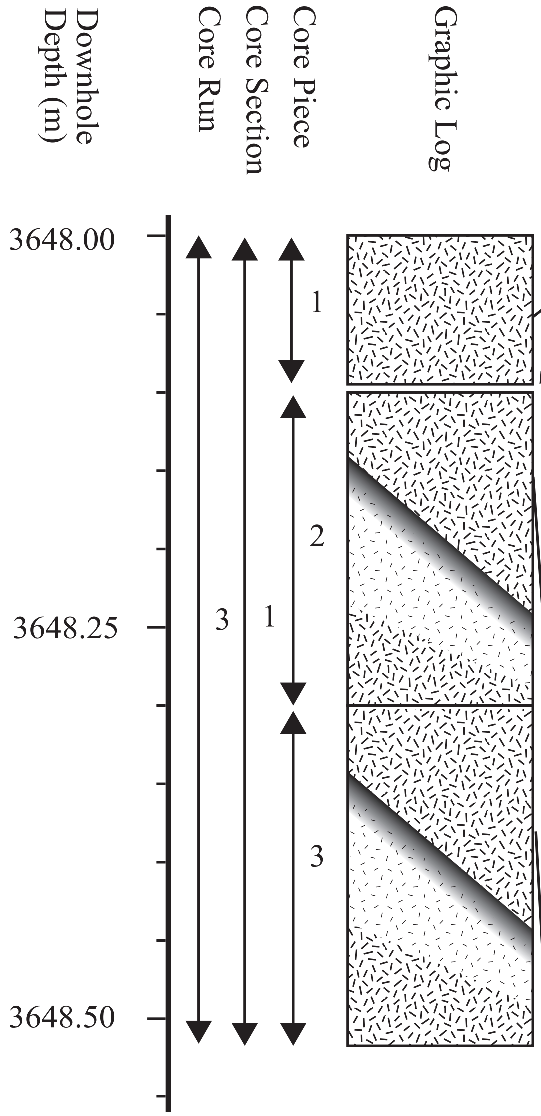

Fine Grained Basalt (Localized shearing, weak mineral alignment, felsic segregation, and shear bands)


Chilled Margin


Pl-Qtz Felsite Veins/Segregations

Ab - Albite
Act - Actinolite
Amp - Amphibole
Anh - Anhydrite
Bi - Biotite
Cal - Calcite
Ccp - Chalcopyrite
Chl - Chlorite
Cpx - Clinopyroxene
Czo - Clinozoisite
Di - Diopside
Ep - Epidote
Grt - Garnet
Hbl - Hornblende
Hem - Hematite
Ilm - Ilmenite
ISS - Cu-Fe sulfide intermediate solid solution
Lmt - Laumontite
Mrc - Marcasite
Mt - Magnetite
Ol - Olivine
Opx - Orthopyroxene
Pl - Plagioclase
Po - Pyrrhotite
Prh - Prehnite
Px - Pyroxene
Py - Pyrite
Qtz - Quartz
Sp - Sphalerite
TiMt - Titanomagnetite
Wo - Wollastonite
Wrk - Wairakite

IDDP-2 Core Run 3
3648.00 to 3648.52 m



Angles are all expressed relative to the core axis.

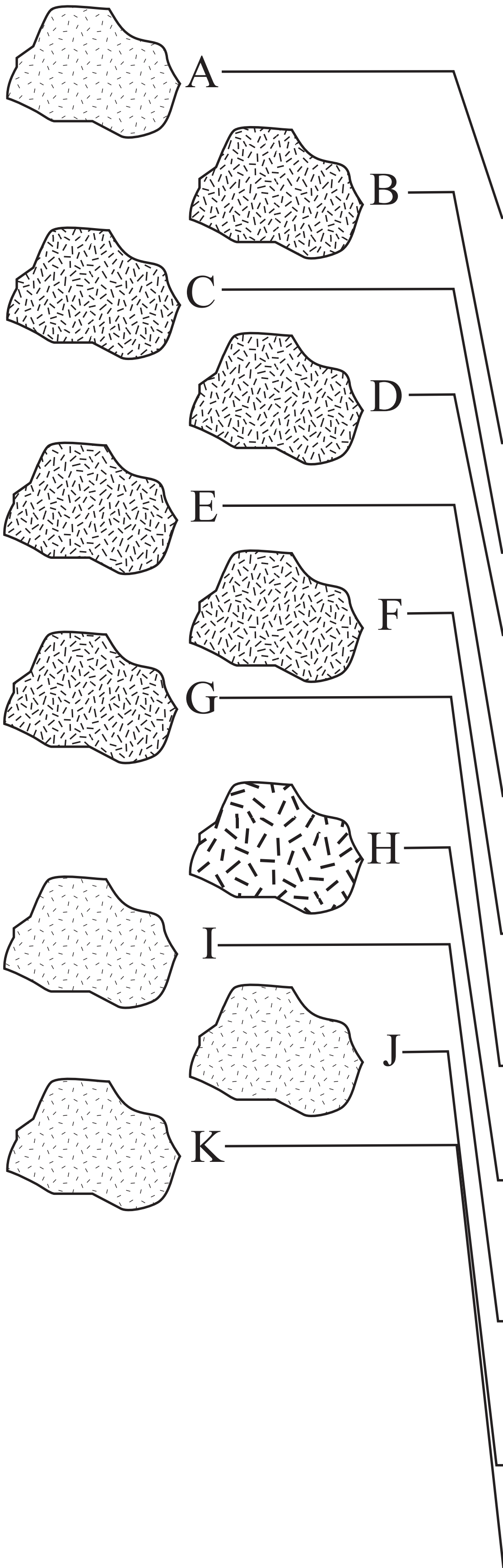
Piece 1: Medium grained greenish grey (5G 6/1) diabase. ~40% Felted interlocking thin lath-shaped Pl 1-2 mm in length, interstitial 1 mm subhedral brown Px (~59%), 0.5 mm euhedral TiMt (~1%). Top surface was cut by the tri-cone bit before coring and is smooth and conical shaped. One surface of the piece is an unmineralized flat plane joint surface parallel to the core axis. 1 mm thick discontinuous Ep vein cuts the plane surface at an angle varying between ~ 75° to ~50°. Core-cut surface shows a series of discontinuous planar veins, all less than 1.5 mm wide, and one white Pl filled vein, ± fine Qtz and Py at ~30°. Other ~10 to 15 mm long and <1 mm wide discontinuous veins are filled with white Pl or Ep. These smaller, less continuous veins can pass from Pl-filled to Ep-filled along the vein trace at angles up to 70°.

Drilling gap of unknown size.

Piece 2: Top similar to piece 1, but with more veining and alteration. Upper broken surface shows irregular veins and patches of Ccp/ISS > Po > Py up to 20 mm long and 4 mm wide associated with patchy Ep alteration. Some acicular Amp cuts across Ccp. Abundant Ep veins and replacement are present on the upper fracture surface. An apparent dike margin dips ~ 50° and is chilled against the interior of the overlying dike. The 20 mm thick chilled contact is sheared with Chl replacement and not intact, suggesting some dike rotation. There is a weakly developed variolitic texture moving away from the margin grading into elongate felted Pl matrix with subhedral interstitial dark blackish-green Px. Slightly darker, more Px rich than unit above. Grain-size increases to ~ 2 mm for both Pl and Cpx at bottom of piece 2. Greenish sheen on coarser Px suggests uralitization. Abundant Ep & Pl veins in three prominent directions. The earliest (vein set 1) set dips 40° and is sub-perpendicular to the chilled margin. Ep and Pl occur in variable proportions; some parts with Pl only. Pl is more common along vein margins & Ep in vein centers, but not always. Some lighter green 1 mm-wide (locally 2 mm) Chl areas overprint Pl along vein margins. Vein set 2 is the most prominent, dip 50° (subparallel to the chilled margin), and the largest is up to 3-4 mm wide but irregular. Veins are dominantly Ep with sub-equal Pl, minor fine-grained Qtz and locally Amp and Py, and darker Chl areas. There are multiple generations of vein opening and some shearing along the vein. Veins pinch,swell and bifurcate along the length. There are no good through going brittle fractures. A third generation (vein set 3) of steeper veins dip up to 30°. These are thinner and later than vein set 2, but tend to merge into them when they intersect. The set 3 veins most parallel to the core axis tend to be more dominated by plagioclase. Many of the smaller veins are discontinuous and show diffuse terminations. One ~0°, 14 x 4 mm vein/pocket of coarser Pl-Qtz-Px-Amp(?) passes into a Pl-Chl patch. Less sulfide than overlying dike, mostly Py with some Cu-Fe sulfide.

Piece 3: Continuation of piece 2 across a core break. Coarsest grain size is near bottom of the piece where a second black chilled margin is quenched against the interior of the upper dike. As in the piece above, the veins are quite irregular and discontinuous. Thinner portions of veins tend to have more Pl and less Ep. Veins on the cut surface seem to have diffuse darker, comminuted and Chl margins suggesting they are formed during shearing. The boundary with the chilled margin of the underlying dike shows some minor sheering along margin with abundant very fine-grained Mt, resulting in dark Chl(?) border between the truncated dike above and the chilled margin. In places the dark Mt-rich zones widen into and replace the dike, locally leaving patches of less recrystallized rock in the sheared rock, such that there is a diffuse brecciated texture near the chill. There are floating patches Ep alteration along the more Chl margin, including areas that could be disrupted veins. The chilled margin has a few 1 mm Pl phenocrysts and very poorly developed sparse Pl microlites. It is cut by a few < 1 mm wide dark green Amp veins that have Pl-rich selvages. One green Amp + Pl vein crosscuts the Mt-rich shear band and continues into the overlying dike.

IDDP-2 Core Run 3
Loose fill (rollers)
from unknown intervals
above core



Piece A (9×7×3 cm): Very fine-grained, <<1 mm light grey basalt with a sugary texture and subhedral Px in an anhedral Pl matrix. One edge of the sample is a breccia vein. Abundant Ep veins and replacement. Some Ep veins contain abundant sugary white Pl(?), and locally Prh(?). Po is abundant, both in Ep veins and disseminated, often round patchy Ep alteration/replacement. Subhedral Py is intergrown with Po, but less abundant and coarser grained than Po. The vein fragments are darker, more Px rich, and coarser grained the bulk rock, but grain size is still less than or equal to 1 mm. Vein matrix is often sugary white, and in places resembles "plagiogranite" but is often filled with Ep + Po ± Py. Thicker Ep veins and patches are intergrown with light blue-green Prh(?) and dark black blocky Amp(?). Ccp is locally present in the Ep veins with Po. The coarsest Ep veins have euhedral Ep up to 3-4 mm intergrown with deep green blocky Amp, and bronzy dark brown Px(?) with Ccp and Po. Some Chl(?) along vein edges. Potential sample for fluid inclusions.

Piece B (8×6×2 cm): Light grey, relatively fresh, anomalously Pl-rich crystalline basalt. Pl is 0.5 to 3 mm and fresh. Rock is <10% clear brown to green <0.2 mm (ortho?) Px, and <10% and <0.2 mm TiMt. There are ~ 5 Pl phenocrysts up to 6 mm, some are slightly greenish due to incipient Chl(?) alteration. Only a few thin veins of white mineral, which can be elongate with cleavage and looks like Pl veins cutting Pl-rich lava. Dominant alteration is local patches of Po, occasionally intergrown with Py.

Piece C (7×6×3 cm): Grey, fresh, equigranular diabase with 1-2 mm subhedral brown, clear Px in a matrix of slightly coarser and somewhat elongated Pl. 5-10% <1 mm TiMt. Minor disseminated Py ± Po.

Piece D (7×5×4 cm): Grey, fresh Pl-rich diabase. Slightly coarser grained Pl, similar Px, and less abundant TiMt than above.

Piece E (4×4×4 cm): Trapezoidal piece of grey crystalline basalt with abundant 1-3 mm laths of felted Pl matrix with 20-30 percent <0.5 mm rounded brown Px. Much of the Px is greenish, suggesting some replacement by Amp, but generally a fresh looking basalt. Dominant alteration is patchy, up to 3 mm, replacement ovals with Po>Py ± trace Ccp.

Piece F (5×4×4 cm): Grey diabase with 65% Pl up to 3 mm, somewhat elongated and 1-2 mm brownish Px with ~5% < 1 mm TiMt. Rare 3-5 mm clear Pl phenocrysts. Mostly fresh with some patchy blue-green (Chl?) alteration. Some disseminated Py.

Piece G (4×3×3 cm): Greenish grey diabase. Somewhat coarser than Piece F and more elongate Pl and more Fe-Ti oxide. Px and/or matrix is locally greenish, suggesting incipient alteration. Py & Po more abundant than Piece F, sometimes in greenish slightly chlorinated patches.

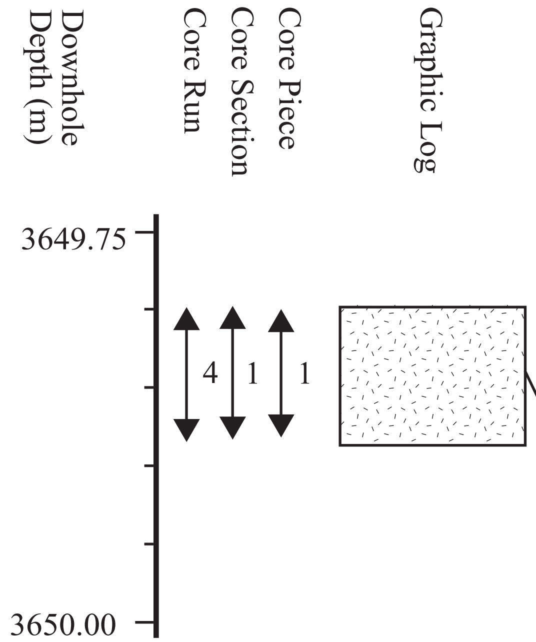
Piece H (4×4×3 cm): Coarser-grained and more mafic diabase than Piece F or G. Pl more lath-like and up to 2-3 mm, a few percent 3-5 mm clear Pl phenocrysts. More abundant sulfide, including more Ccp than pieces above.

Piece I (4×3×2 cm): Fine-grained greenish (chloritized ?) altered basalt, with abundant Fe-Ti oxide. One surface from a coarse Ep-Amp-Po vein. Elongate radial splays of euhedral Ep up to 5-6 mm with blocky subhedral dark green Amp, up to 6-7 mm. Fine-grained aggregates of Po with some Ccp.

Piece J (3×2×1 cm): Same as above with some voids filled with Ep and one 5 mm vesicle lined with euhedral Ep growing inward and then filled with very fine white silky mineral. Vein surface similar to above. Potential sample for fluid inclusions.

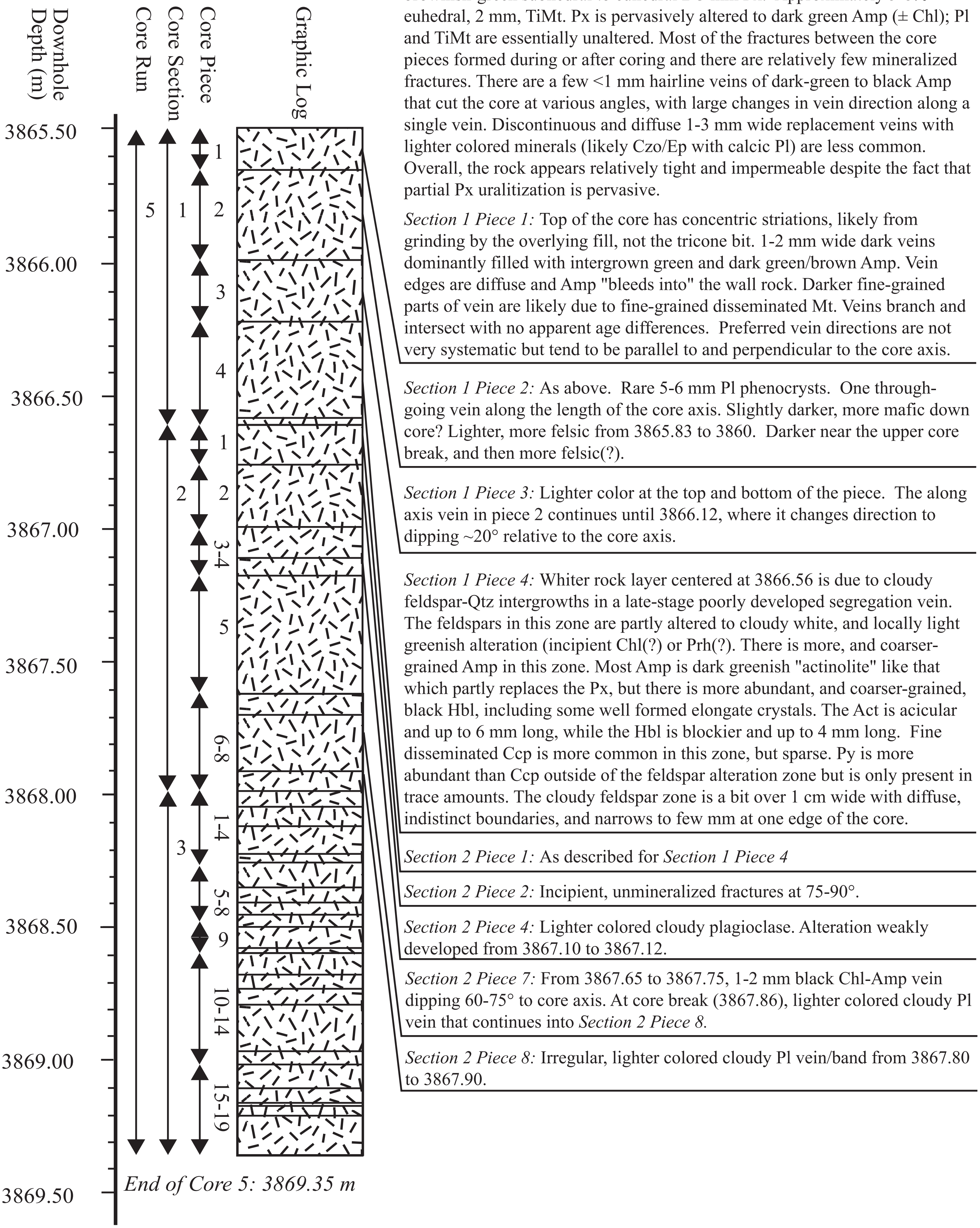
Piece K (2×1×1 cm): As above, but finer grained basalt with more Ep-filled voids. Similar vein on one face, but Amp is browner and tends to be on the vein selvage.

IDDP-2 Core Run 4
3649.80 to 3649.805 m



One 17 x 10 x 5 mm fragment discovered lodged between the core liner and core barrel, definitely from Core Run 4. One edge of the fragment is clearly cut by the core bit. The rock is a fine-grained diabase with subequal proportions of intergrown Pl and Px with several percent TiMt; grains are sub to anhedral and ~1 mm. There is no obvious alteration but there are patches of Po + Ccp that appear secondary, but could be immiscible magmatic sulfide.

IDDP-2 Core Run 5
3865.50 m to 3869.35 m



Core run 5 recovered 3.85 m of continuous core, with no missing intervals or coring gaps. The recovered core is a relatively homogeneous dark greenish grey (5G 4/1) basaltic intrusion. It is composed of subequal amounts of euhedral, clear, blocky to slightly elongate 3-5 mm Pl, with interstitial brownish-green subhedral to euhedral 2-3 mm Px. Approximately 5-8% euhedral, 2 mm, TiMt. Px is pervasively altered to dark green Amp (± Chl); Pl and TiMt are essentially unaltered. Most of the fractures between the core pieces formed during or after coring and there are relatively few mineralized fractures. There are a few <1 mm hairline veins of dark-green to black Amp that cut the core at various angles, with large changes in vein direction along a single vein. Discontinuous and diffuse 1-3 mm wide replacement veins with lighter colored minerals (likely Czo/Ep with calcic Pl) are less common. Overall, the rock appears relatively tight and impermeable despite the fact that partial Px uralitization is pervasive.

Section 1 Piece 1: Top of the core has concentric striations, likely from grinding by the overlying fill, not the tricone bit. 1-2 mm wide dark veins dominantly filled with intergrown green and dark green/brown Amp. Vein edges are diffuse and Amp "bleeds into" the wall rock. Darker fine-grained parts of vein are likely due to fine-grained disseminated Mt. Veins branch and intersect with no apparent age differences. Preferred vein directions are not very systematic but tend to be parallel to and perpendicular to the core axis.

Section 1 Piece 2: As above. Rare 5-6 mm Pl phenocrysts. One through-going vein along the length of the core axis. Slightly darker, more mafic down core? Lighter, more felsic from 3865.83 to 3860. Darker near the upper core break, and then more felsic(?).

Section 1 Piece 3: Lighter color at the top and bottom of the piece. The along axis vein in piece 2 continues until 3866.12, where it changes direction to dipping ~20° relative to the core axis.

Section 1 Piece 4: Whiter rock layer centered at 3866.56 is due to cloudy feldspar-Qtz intergrowths in a late-stage poorly developed segregation vein. The feldspars in this zone are partly altered to cloudy white, and locally light greenish alteration (incipient Chl(?) or Prh(?). There is more, and coarser-grained Amp in this zone. Most Amp is dark greenish "actinolite" like that which partly replaces the Px, but there is more abundant, and coarser-grained, black Hbl, including some well formed elongate crystals. The Act is acicular and up to 6 mm long, while the Hbl is blockier and up to 4 mm long. Fine disseminated Ccp is more common in this zone, but sparse. Py is more abundant than Ccp outside of the feldspar alteration zone but is only present in trace amounts. The cloudy feldspar zone is a bit over 1 cm wide with diffuse, indistinct boundaries, and narrows to few mm at one edge of the core.

Section 2 Piece 1: As described for *Section 1 Piece 4*

Section 2 Piece 2: Incipient, unmineralized fractures at 75-90°.

Section 2 Piece 4: Lighter colored cloudy plagioclase. Alteration weakly developed from 3867.10 to 3867.12.

Section 2 Piece 7: From 3867.65 to 3867.75, 1-2 mm black Chl-Amp vein dipping 60-75° to core axis. At core break (3867.86), lighter colored cloudy Pl vein that continues into *Section 2 Piece 8.*

Section 2 Piece 8: Irregular, lighter colored cloudy Pl vein/band from 3867.80 to 3867.90.

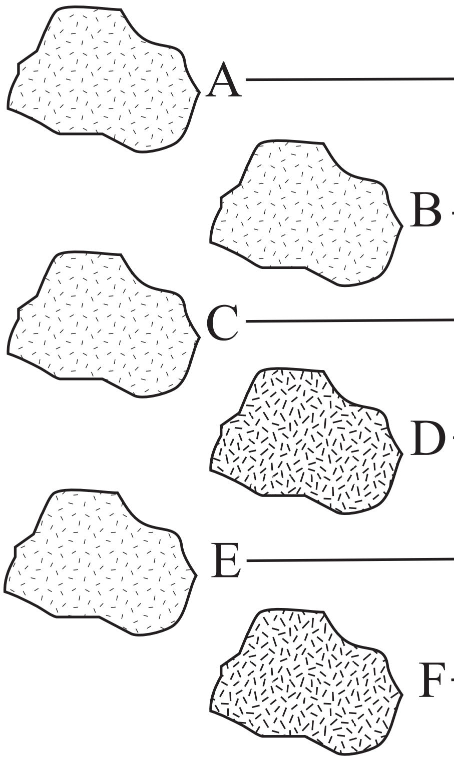
Section 3: There are fairly regularly spaced fractures breaking what was continuous core into 5-15 cm core pieces. The fractures are unmineralized and clearly formed after coring, and most like related to the extensive hammering of the core barrel (with a hard rubber mallet) that was necessary to extract the core from the core barrel using hydraulic pressure. Typical fractures in *Core 5 Section 3* are approximately perpendicular to the core axis and refract to approximately 30°, which suggests that the fractures are refracting into what would have been the horizontal and are forming due to stress relief from vertical unloading during or following coring.

Section 3 Pieces 9 and 10: Lighter colored irregular 2-3 mm thick replacement vein dipping ~ 50° to the core axis from 3868.55 to 3868.63. The white veins are defined by cloudy Pl and have diffuse boundaries with the wall rock. There is abundant greenish "actinolite" within the bleached zone, including 3-5 mm blocky acicular crystals. Blocky, elongated, but less acicular, 3-5 mm black Hbl crystals are less abundant. There appears to be some addition of fine-grained Qtz in the central area of the vein. Fine-grained (<1 mm) Py is common in and along the vein trace. Py is more abundant in the area 1-2 cm around the vein than it is in the rock in general.

Section 3 Piece 18: Dipping fracture surface forming part of the bounding surface at the bottom of *Section 3 Piece 17* and a part of the upper surface of *Section 3 Piece 18* represents a pre-coring fracture that is weakly coated by dark blackish green Chl (3869.21 m). The mineral coated fracture is at ~ 75° to the core axis.

Section 3 Piece 19: Lighter colored, dusty Pl-rich band from 3869.21-3869.35. The top of the *Section 3 Piece 19* shares a part of the mineralized fracture described above. *Section 3 Pieces 18 and 19* were once continuous, but *Section 3 Piece 19* was trapped by the core catcher and spun in the process of removing the bit, which ground away some of the core. There are no systematic changes in grain-size that are obvious over the 3.85 meters of Core 5.

IDDP-2 Core Run 5
Loose fill (rollers) from unknown intervals above core



Piece A (11×6×5 cm): Fine-grained green-grey altered basalt extensively veined by Ep. Sparse 1 mm Pl phenocrysts and 1 mm spherical vesicles filled with Chl ± Py. Two prominent 3-4 mm wide Ep veins with ladder veining in between and numerous 3 to < 1 mm Ep veins in multiple orientations. Only minor offsets at vein intersections and all veins appear to be the same generation. The largest veins are open space filling, with some residual open pore space with euhedral, terminated Ep crystals. Many of the open vugs have hair-like needles of intergrown acicular white Act. There are subordinate amounts of Pl ± minor Qtz(?) in the thickest veins and these veins often have a sugary, porous margin of crystalline cloudy Pl. Locally, some larger euhedral clear to dark green crystals in the veins that appear to be late Di. These are most common in the Pl-rich area, and especially in some late vugs in the vein filled with extremely fine-grained sugary crystals. Many of the veins contain Py, some up to 2 mm. Locally, the Py is intergrown with Ccp. The thinner veins have proportionally more Pl, including intervals and veins with no Ep. Individual veins can grade from all Pl to all Ep along the vein trace. Most of the rock has a greenish color due to Chl alteration, but some veins, particularly the largest ones, have a selvage that is more bleached, greyer, and is more porous than the bulk rock. There are some curious Fe-oxides in very trace amounts in some of the vein vugs, including a couple of very small hollow broken spheres of Fe-oxide deposited on the walls of bubbles that resemble the Hem staining seen in Cores 11-13

Piece B (9×5×5 cm): Irregular fine-grained greenschist altered basalt. Some core-bit cut surfaces, but likely cored as coarse fill. Some distributed 1 mm vesicles filled with dark green Chl. One Ep vein up to 3 mm thick, and some smaller ones. Fairly abundant sulfide, most of which is Cu-Fe sulfide with a color and morphology consistent with isocubanite/ISS.

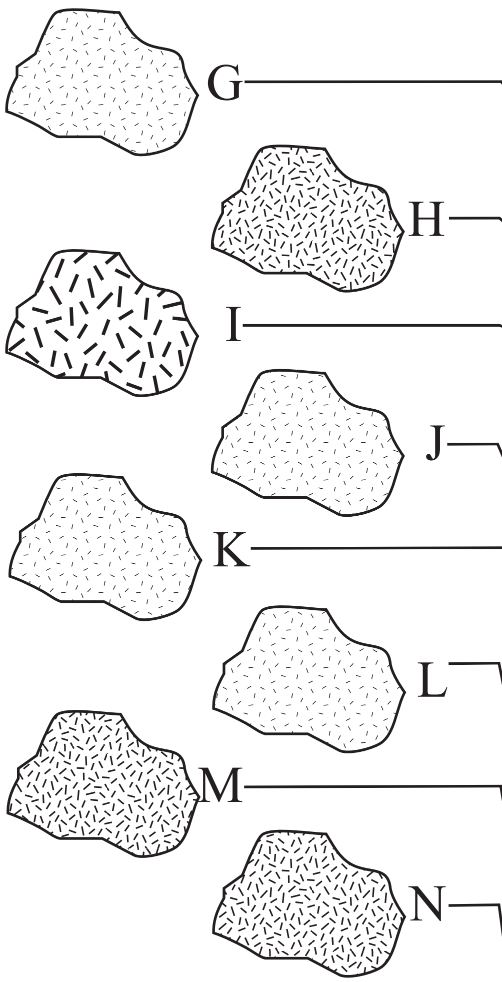
Piece C (8×6×5 cm): Angular fill with a small saddle-shaped surface cut by the core bit. Two small patches of cement are stuck to the rock indicating it must have come from the uppermost part of the hole. The rock is a fine-grained basalt that is highly altered and extensively veined, possibly from a major feed zone. Veins are dominantly Ep, irregular, discontinuous, replacement-style veins without a lot of evidence for open space fill. Some vuggy pockets in the Ep have fine intergrown hair-like crystals of Act. The rock matrix appears to show abundant Chl, Ep and Act alteration. Some discontinuous fracture surfaces have poorly developed slicken lines. Sulfide is abundant and includes some good cubic Py and some Cu-Fe sulfide.

Piece D (6×5×4 cm): Medium-grained holocrystaline basalt with several drill cut surfaces at various angles. Rock extensively altered with cloudy Pl, green altered Cpx and localized Ep flooding > Amp. Ep + Amp vein. Rare Ep lined vesicles later filled with Amp and a white mineral (Pl?), and perhaps some Di. Py > Ccp.

Piece E (6×5×2 cm): Fine-grained, homogeneous relatively unaltered dike margin or flow margin. Interlocking network of elongated <1 mm Pl crystals, with interstitial fine-grained TiMt crystals and interstitial material with Px that has greenish-blue alteration color. Some disseminated Py in the matrix.

Piece F (6×4×4 cm): Medium-grained holocrystalline basalt pervasively altered to Amp and flooded and veined by Ep. Essentially all of the Px is replaced by Amp and Pl is highly altered. Ep veins include coarse dark green Amp and sugary Qtz(?) or Pl(?). Sulfide is abundant, mostly Py. Several pockets of felted mats of asbestiform white Act (of the type commonly logged as Wo). Some of the material in the veins and matrix looks like Di and there is one vein-like mass of green-yellow Grt(?). Oxidized patches have elongate prisms of a clear mineral with the morphology of Anh, but it appears to be too hard to be a sulfate.

IDDP-2 Core Run 5
Loose fill (rollers)
from unknown intervals
above core



Piece G (5×4×4 cm): Quenched, but not glassy, basalt with sparse Pl microlites, the largest of which show compositional zoning. Abundant 3-6 mm vesicles filled initially with dark green Chl, but many with later in fills of Py, blue-green Prh(?), Ep ± Amp, and possibly some Grt. Cut by 3-4 mm Ep vein with common Py and minor Pl. Uncut side of sample shows coarse subhedral Pl and Qtz as both pockets and veins developed on one side of the Ep filled vein.

Piece H (5×3×3 cm): Medium-grained intrusive(?) basalt. Similar in grain-size to the cored interval, but appears slightly more mafic, less altered and has less elongated Pl. There appears to be a weak mineral orientation fabric.

Piece I (7×5×2 cm): Basaltic dike similar to cored interval.

Piece J (5×4×2 cm): Fine-grained vesicular basalt. Vesicles generally lined with coarse, radiating dark Chl and often filled with later Ep. Some vesicles have Qtz-Ep, and some have minor Prh and possibly Di. Cut by a 3 mm Ep vein with minor Amp, rare Di(?), and minor Pl and Qtz. Sulfides fairly abundant in vesicles, vein, and in matrix with Cu-Fe sulfide > Py, both of which can show euhedral crystal forms.

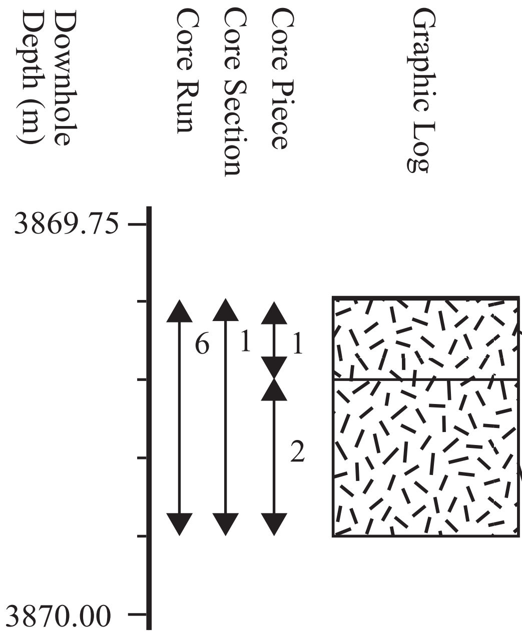
Piece K (4×4×2 cm): Fine-grained basalt with a quench surface on one side. Slightly vesicular with Ep > Chl in vesicles. Extensive development of patchy Ep alteration in the matrix, including coarse crystalline Ep. Locally intergrown with Qtz. Vuggy pockets filled with matted asbestiform greenish Act. Sulfide is fairly abundant and usually associated with Ep, with Py > Ccp. One crystal of Mrc intergrown with Ep.

Piece L (7×5×5 cm): Fine-grained basalt, locally showing quenched texture. Slightly vesicular with Chl-Ep fill. Abundant veins and patches of coarse, radial elongate Ep, locally with late stage euhedral Qtz and some late, darker green crystalline Amp. Fine-grained acicular Act common along vein margins.

Piece M (7×4×3 cm): Medium-grained basalt, possibly intrusive, pervasively altered to Amp plus Ep. Pl is also altered. Probably collapsed from the borehole wall. Some coarse Ep veining and replacement. Minor Qtz with Ep. Sparse sulfide.

Piece N (6×4×3 cm): Medium-grained basalt pervasively altered to Amp with some patchy Ep. Pl is altered. Cut by several anastomosing Ep veins with Amp, and locally minor Pl and Qtz(?). Only minor Py. There are a few irregularly shaped gas cavities or vesicles filled with Ep, minor Chl(?) and Amp, a few of which show red oxidation patches, which are more orange than typical for Hem.

IDDP-2 Core Run 6
3869.80 to 3869.95 m

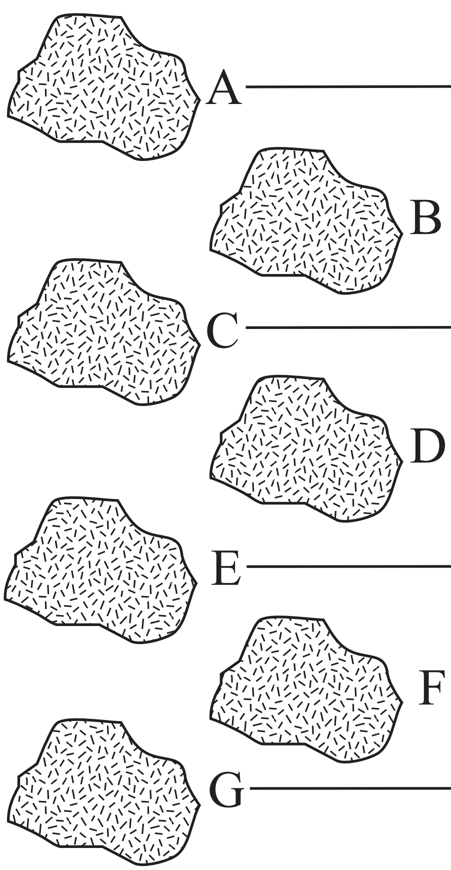


Dark greenish grey basalt identical to the unit cored in Core run 5. ~30 cm of fill recovered with the core.

Piece 1: Fragment, cored on one side, slightly less then 1/3 of the circumference is a cut core surface.

Piece 2: As above. Fresh fracture along the vertical axis of the core. The fractured face has a lineation perpendicular to the core axis. The lineation is a stepped "tectonic" fracture and not the original igneous fabric. At 3868.87 there are two subparallel 1 mm thick black Chl+Amp veins separated by ~ 1 cm, similar to those in Core 5. In places the fractures split into finer fractures, and in one place the two largest start to merge. The fractures vary in dip from about ~85° to ~65° to the core axis, with an average dip of about 70°.

IDDP-2 Core Run 6
Loose fill (rollers) from unknown intervals above core



Piece A (17×8×2 cm): Thin fracture-bound porphyritic diabase dike fragment showing multiple stepped fracture surfaces related to 2-3 mm thick sub-parallel incipient fractures. The fracture surfaces are fresh and formed as the result of the drilling process. Given the length of this fragment, which is greater than the diameter of the drill hole, the fractures are highly likely to be sub-vertical. The rock is relatively unaltered with fresh Pl, minor alteration of the Px to Amp, and patchy alteration in the interstitial material. Pl forms euhedral, 2 mm elongated crystals, and Px forms equant 1 mm equant crystals that are clear glassy brown where unaltered. Px and Pl are present in near equal proportions, with only 2-3% TiMt, which means that the rock is lighter-colored, and appears more felsic, than most of the dikes. The rock is slightly porphyritic with about 5% Pl phenocrysts, which are only slightly larger (3-4 mm), but more blocky in shape, than the groundmass Pl.

Piece B (6×5×2 cm): Similar to *Piece A*, but without well-developed incipient fractures, somewhat finer-grained, and not porphyritic.

Piece C (7×4×3 cm): Similar to B, but more obvious Amp alteration of some of the Px.

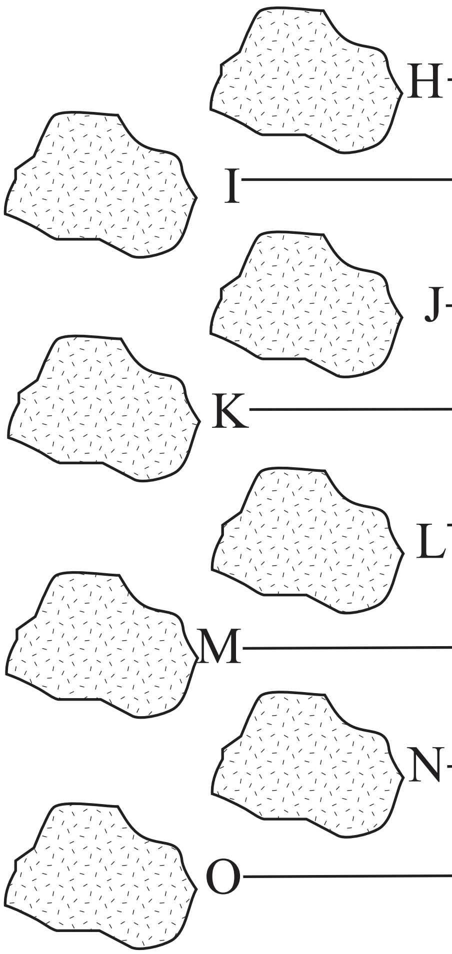
Piece D (5×5×3 cm): Porphyritic diabase, very similar to A, but lacking penetrative incipient fractures.

Piece E (13×7×4 cm): Fracture bound slab similar to A, but fractures less prominent and rock is not porphyritic.

Piece F (6×6×2 cm): Fracture bound slab similar to A, weakly porphyritic.

Piece G (9×9×3 cm): Porphyritic diabase. Fracture bound slab identical to A with well-developed, closely spaced incipient factures.

IDDP-2 Core Run 6
Loose fill (rollers) from unknown intervals above core



Piece H (9×6×4 cm): Very fine-grained (<1 mm) light grey holocrystalline basalt with sparse 1 mm Pl phenocrysts and rare 1 mm Px phenocrysts. Greenish tinge to the Px suggest some alteration to Act. Patchy sulfide mineralization common, with Py more abundant than Ccp. One surface coated with vein Ep + Py. A few 1 mm thick white veins of Pl + Qtz, and a few 1 mm veins of Ep + Py, one of which transitions into a Pl dominated vein along the vein trace.

Piece I (5×3×3 cm): Rounded grey-green altered Pl porphyritic basalt. Sparse 1 mm Pl phenocrysts, some partially replaced by Ep. Pervasively altered and veined with Ep. Large Ep vein invading brecciated rock with angular 2-5 mm breccia fragments floating in the Ep matrix. Ep is accompanied by abundant very fine-grained Act, with some euhedral Pl and minor Qtz. Sulfide is common, mostly Ccp and Py, some of which is intergrown with Mt.

Piece J (5×5×5 cm): Rounded grey-green altered basalt. Px pervasively altered to Act. Locally brecciated and highly veined and replaced by Pl>Ep>Qtz>Py>Ccp ± Mt. Mt is locally abundant as a vein mineral. Some veins may have some hydrothermal Cpx. Some of the veins have open space filling textures with euhedral terminated Pl and Qtz. Some dominantly Py veins. Good sample for fluid inclusion and sulfide studies.

Piece K (6×6×5 cm): Irregular, rounded grey-green highly altered basalt. Extensively altered to Ab-Act-Ep. Multiple cross cutting Qtz-Ep-Pl veins. Good open space filling crystals in some veins. Py is common in veins, locally with Ccp. A few small areas of Mt mineralization on the margins of some veins. Minor amount of late Cal. Good sample for fluid inclusion and sulfide studies.

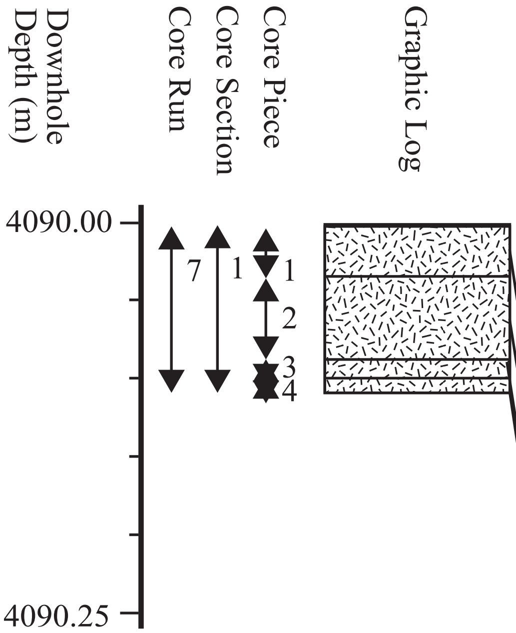
Piece L (9×5×5 cm): Glassy basalt with abundant amygdales and sparse, very small Pl microlites that coarsen across the sample to ~1 mm. Some quenched Px in the matrix. There may have been a few Ol phenocrysts, now replaced by dark phyllosilicate. Vesicles and irregular gas cavities completely filled with silica-smectite with some showing late dark crystalline Chl in the centers. Maybe some Prh in some vesicles? A few vesicles seemed to have late-stage Di crystals. Some large patches of very fine Po in some of the vesicles, and occasional patches of Po in the matrix. No Ccp on the cut surface, but the uncut surface has fairly abundant Ccp with minor Sp. Some Ccp smeared along the surface of the rock. Some patches of zeolite? Maybe some Lmt(?).

Piece M (5×4×4 cm): Fine-grained sugary textured basalt, highly altered to Ab-Chl-Act(?). Numerous veins of Qtz-Pl-Ep, some with abundant sulfide. Local pockets of Py-Ccp-Sp intergrown with open space-filling Qtz-Pl(?). Some Mt intergrown with some of the sulfide and some small patches of Mt mineralization.

Piece N (4×3×2 cm): Fine-grained Pl-phyric, Mt-rich basalt cut by several discontinuous veins of Qtz-Pl-Ep-white Act. Some well crystallized Py in the matrix.

Piece O (3×3×2 cm): Very fine-grained basalt cut my numerous, anastomosing, discontinuous veins of Pl-Qtz-Ep-Act. Dominantly Py in the rock matrix, and Py-Ccp-Mt in the veins.

IDDP-2 Core Run 7
4090.00 to 4090.12 m



Core 7 recovered 12 cm of fine-grained incipiently altered diabase dike. The drilling process induced the core to brake into 4 disk-like fragments with the breaks perpendicular to the core axis. There is a weak lineation on the fracture surfaces that is roughly parallel from core break to core break. Although the lineations have the appearance of tectonically related fractures, there does appear to be a slight alignment of Pl, and to a lesser extent Px, along the lineation direction. Rock is approximately 55% Pl, 40% Px, and 5% TiMt, with trace Ol(?). Pl occurs as clear, elongate crystals up to 4 mm but generally about 2 mm. On the cut surface, some Pl is slightly cloudy and greenish due to incipient alteration. There are sparse blocky Pl phenocrysts/glomerocrysts up to 5-6 mm across, and these are also incipiently altered. The Cpx is generally 2 x 2 mm in cross section, with some grains more elongated up to 4 mm. The elongated Px is also weakly aligned with the Pl. The Px is black to dark brown and appears to be clear and unaltered on the fracture surfaces, but the cut surface shows that there is variable alteration to grey-green Amp. It is estimated that about 60% of the Cpx is unaltered. The finer-grained interstitial patches show more pervasive greenish-blue patchy alteration. TiMt is much less abundant than in the overlying dikes, and is generally 2 mm and subhedral. A few green-brown, glassy, equant 2 mm grains with conchoidal fracture appear to be unaltered Ol. There are some sparse 1-2 mm patches of sulfide, dominantly Po, but including some Ccp that appears to be authigenic rather than immiscible sulfide.

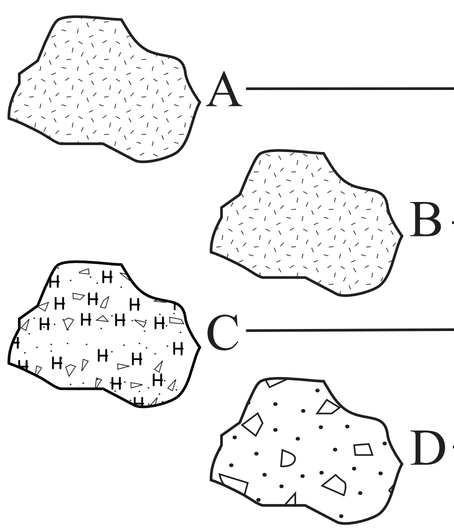
Piece 1: As above

Piece 2: As above with a few sparse blocky Pl phenocrysts up to 5 mm across.

Piece 3: Slightly more Po on bottom fracture surface.

Piece 4: As above.

IDDP-2 Core Run 7
Loose fill (rollers)
from unknown intervals
above core



Much of the fill is angular and derived from the same dike as the material that was cored. However, some of this material is clearly finer grained, and a portion is clearly coarser-grained equivalents of the same dike suggesting: 1) the dike was rather thin in order to account for the changes in grain size, and 2) the upper margin of the dike was fractured prior to drilling.

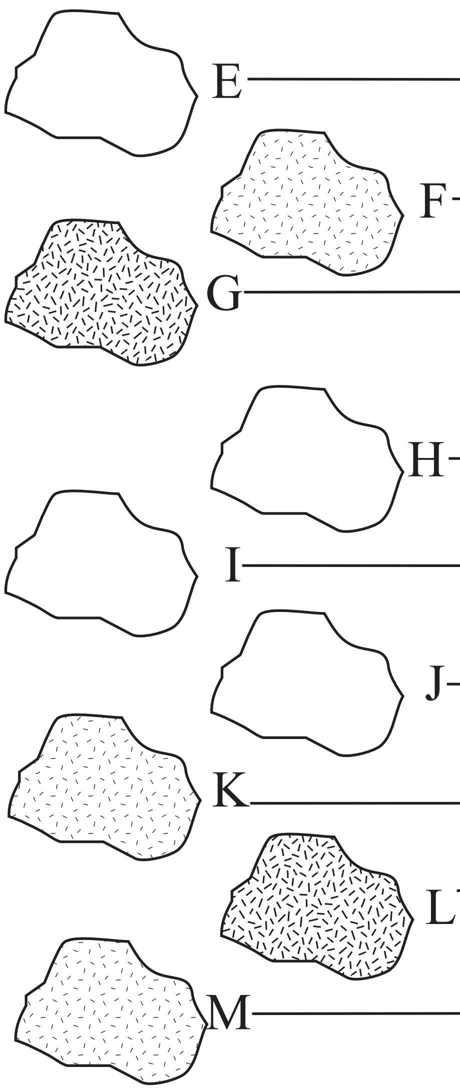
Piece A (10×5×3 cm): Fragment spalled off of the drill hole wall with a bit cut surface on one side. Fine-grained diabase dike. Finer grain size than the cored interval. Also appears less altered than the cored interval.

Piece B (8×6×3 cm): Fine-grained light grey holocrystalline basalt (likely the same as *Piece K*), with interesting vesicle fills. Generally, an inner rim of coarse, black, well-crystallized, radially arranged platelets of Chl, with black blocky crystals of Hbl and probably Mt. Strongly magnetic. There is often a replacement rind of Ep outlining, but not filling, the vesicles, and there is a minor amount of Ep in the vesicle fill. One thin vesicle has a lining of finer-grained material with the blue-green color of Prh. Volcanic matrix seems reasonably fresh, but cut by many 1-2 mm Ep veins, which also coat many of the surfaces of the clast. Ccp is relatively abundant in the Ep veins.

Piece C (8×7×3 cm): Green silicified hyaloclastite with abundant vesicular fragments. Several surfaces have been polished by the drill sting in different orientations. Rock must have fallen against the string. Pervasively altered, but the fine-grained alteration is hard to quantify. There is abundant Ep and Qtz filling porosity, but it appears as if a lot of the finer alteration may be Di(?) + Grt(?). Maybe some Prh, and possibly some zeolite (likely Wrk) in some vugs. The fractured surface is covered by powdery white Anh(?), Chl, very fine Sp(?) with coarse patches of Ccp intergrown with euhedral clear elongate tabular crystals that are probably Anh. Rare, coarse Sp, and minor Po. Some Qtz intergrown with Ccp.

Piece D (5×5×3 cm): Hyaloclastite sandstone/siltstone on one side in contact with the quenched margin of a basalt clast on the other. 1-4 mm Ep vein developed along the contact. Several other Ep + Qtz veins cut the rock in different directions. Some faces polished by drill string.

IDDP-2 Core Run 7
Loose fill (rollers)
from unknown intervals
above core



Piece E (x×x×x cm): Not logged.

Piece F (6×6×2 cm): Fine holocrystalline basalt. Fairly dark/mafic. One surface was cut by the drill bit before this spalled into the hole. Some large vesicles and cavities, some are filled with Qtz + Ep ± [Di/Grt(?) - different color than the Ep]. Some veins of only Ep. Local albitization of the Pl. Sulfides include Py and Ccp ± Po. Some hydrothermal Mt?

Piece G (7×7×4 cm): Drilled bore hole surface on one side. Mostly medium-grained equigranular basalt, but finer grained and more vesicular on one side. Vesicles filled with Qtz + Ab (+ Anh?) and/or Chl. Some patchy albitic alteration. Lots of Ep in veins, vugs, and as replacement. Sulfide very abundant on some vein surfaces associated with white Ab, Qtz, talcy material and maybe some Anh. Some elongate clear vitreous crystals that could be coarse Anh, but could be Qtz. Seemed to be soft enough to scratch. Lots of Ccp on some vein surfaces with less abundant Py ± Po and locally hydrothermal Mt ± Chl.

Piece H (x×x×x cm): Not logged.

Piece I (x×x×x cm): Not logged.

Piece J (x×x×x cm): Not logged.

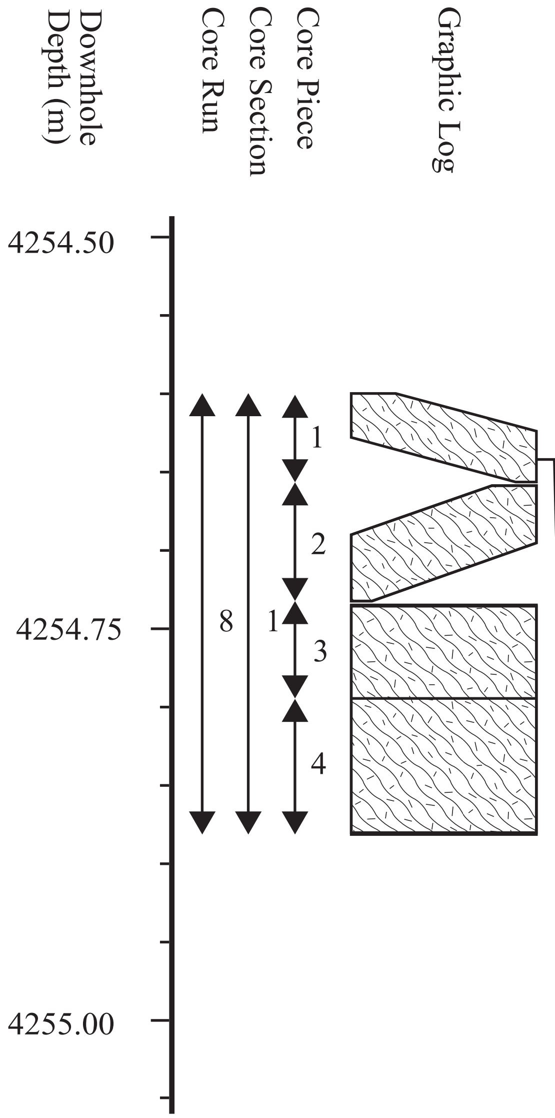
Piece K (10×6×4 cm): Fine-grained, equigranular grey basalt. Large vesicles lined with black, metallic-looking coarse radial Chl followed by Ep. The chloritic areas are strongly magnetic and probably have intergrown Mt. There may be some black blocky Hbl in the vesicle centers. Some surfaces are veins of radial fibrous Ep with minor Chl, minor Hbl and minor fine-grained Qtz. Localized whitish veins of Pl with minor Qtz. Sulfide is relatively abundant and includes good Ccp, Sp, Po and Py.

Piece L (4×4×2 cm): Medium-grained Px-rich basalt with patchy alteration to light green Amp. Cut by several 1 mm milky Qtz veins with abundant disseminated Ccp on the vein surfaces. Some crystalline Qtz (or Anh?) in the veins. Some light colored Ep along the Qtz veins.

Piece M (4×4×4 cm): Rounded and polished cobble of fine-grained crystalline basalt cut by several Qtz veins. Some Qtz is euhedral and there is a little open space left in a few vein centers. Veins contain Qtz > Ep >> Amp > Py > Ccp. Some crystalline Chl.

Miscellaneous: There are several other undescribed fragments that appear different from the cored dike. These include both medium grained crystalline basalt and fine to medium grained intrusives. Some of the fragments seem to be very Px-rich and more mafic than most of what has been drilled. Some are distinguished by being porphyritic. Most show differences in both grain-size and degree of alteration. Several are veined, mostly by Ep, but one mafic medium-grained intrusive has good Qtz + Py + Ccp veins.

IDDP-2 Core Run 8
4254.60 to 4254.88 m



The core and majority of fill fragments consist of fine- to medium-grained basalt (intrusive?) completely replaced by very fine-grained Hbl, secondary calcic Pl, and subordinate metamorphic TiMt and Ilm. The veining, sheering and recrystallization suggest this interval may be a screen between younger dikes. The following mineral identifications were confirmed by XRD and Electron Microprobe (EPMA) analysis of a fill fragment. This unit is composed of approximately 60% black to dark green equant to slightly elongate Hbl with a ~1 mm grain-size that replaces original Px, and locally Pl. There is a weakly defined foliation approximately perpendicular to the core axis developed locally. Hbl forms some cross cutting monomineralic replacement veins and is locally developed in shear-bands. The shear bands include abundant fine-grained calcic Pl and fine-grained disseminated Mt and Ilm. Some Pl in the shear bands show small peaks (Energy Dispersive Spectrometer) for Cl and S suggesting minor amounts of a scapolite-like component, but this needs further confirmation. Approximately 30-35% of the rock is calcic Pl, most of which pseudomorphs igneous Pl. There are minor Na-rich Pl patches are likely relict Ab replacement, but this Pl now has intermediate compositions with sub equal Na and Ca. Pl in the matrix tends to be equant and coarser grained (~2 mm). There less preservation of the original igneous texture and stronger development of a weak metamorphic fabric in the cored interval compared to many of the fill fragments. This could in part be due to the smaller original grain size. There are weakly developed of felsic segregation bands dominated by Pl in the cored interval and some of the fill fragments, at least one of which contains trace mm-size Bi books. Some of these bands pinch out into thin, discontinuous feldspar-Qtz veins. There are a few mm-thick, irregular, discontinuous Qtz replacement veins. Cu-Fe sulfides are present, especially in shear-bands and felsic segregations.

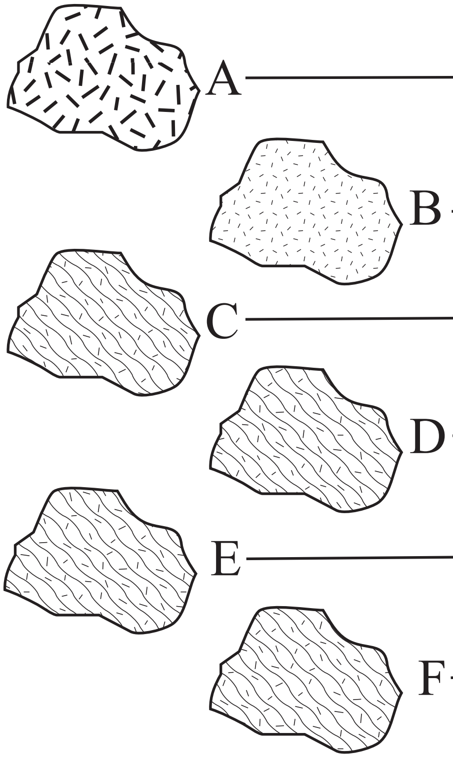
Piece 1: Piece 1 and 2 were cored *in situ*, and are therefore included as part of the recovered core (as opposed to the fill), but the fragments are smaller than the diameter of the core barrel such that the stratigraphic relationships are uncertain. The smaller piece is arbitrarily put at the top. Pieces 1 & 2 are both stratigraphically above piece 3. Piece 1 (*8×3×6 cm*) has one core cut surface, the longest dimension (8 cm) is at an angle to the core axis that is bounded on both sides by sub-planer fracture surfaces perpendicular to the core axis, and extends about 6 cm in the downhole direction. The fracture surfaces have weak lineations. Most of Piece 1 is a relatively coarser grained (1-2 mm) Hbl-rich rock similar to below, with very weakly developed foliation. This piece has one of the largest and best developed Pl segregation lenses, which is up to 1 cm across, has equant Pl crystals up to 3 mm, and has between 5% and 20% mafic minerals. Locally the lens is in contact with a very fine grained to cryptocrystalline black flinty rock up to 1.5 cm thick, which appears be a chilled margin, but could be a comminuted and recrystallized shear band. A 1-2 mm "dike" of this fine rock branches off and cuts the felsic pod, leaving a thin screen of the felsic rock between the 'dike' and the fine black band. Following the contact, the Pl lens intersects the black flinty rock at an angle such that there is a contact between the black flinty rock and the amphibole rock. In one area there appears to be a concentration of Mt developed at the contact between the Pl segregation and the fine-grained rock. In this area, the rock is more granular, less flinty and may include some fine-grained Bi, or the rock may be incipiently crushed to a fine gouge. The black fine-grained rock is present on the opposite side of the fragment from the drill bit cut surface, where the fragment wedges out. The limited geometry suggests the contact is roughly parallel to the core axis, but the contact is too short to define a definitive angular relationship. A series of slightly conical ridges occur on the fracture surface of the finest grained part of this zone, trending perpendicular to the core axis. These may be mini shatter cores from thermal fracturing of the rock due to cooling while coring? There is a prominent Pl-Qtz vein with minor Mt and Ccp crystals on one fracture surface. The Pl-Qtz vein wedges out from 2 mm thick to nothing over the 2.5 cm length of the vein trace. One side of this vein has a grey green patch that faintly preserves a fine-grained igneous dike texture with 2 mm felted elongate Pl laths and interstitial Px replaced by Amp. This patch seems to be a thin coating on the rock. Adjacent to the core cut surface, there is another cm scale patch of very-fine grained sugary textured rock that appears micaceous. This is in contact with the coarsest grained, and most mafic, part of the rock. The rock here has the appearance of pyroxenite with blocky brownish crystals, but this fades into the more amphibolite looking rock.

Piece 2: Largest fill fragment (*10×5×7 cm*) of this unit, which has core-cut surfaces on two sides (10 cm), and was clearly cored from the same unit as the more intact core (*Pieces 3 &4*). It is bounded by a weakly developed fracture sub-parallel to the core on one side, a more irregular break on the other side (5 cm), and is 6.5-7 cm in length down hole. The igneous protolith texture is not as well preserved in this fragment as *Piece 1*, and it is finer-grained compared to some of the fill fragments. There are only a few discontinuous Pl-Qtz-Cu-Fe sulfide (± Amp) veins, which pinch out into fracture traces. There are sub-mm fractures mineralized with Amp on the cut surface. There are also dark, anastomosing fine-grained recrystallized shear bands. The shear bands cut the Pl-Qtz veins. The Amp-mineralized fractures merge into, and locally cut, the shear veins. A 1-2 cm thick dark fine-grained flinty zone, likely a chilled zone continuous with the one in *Piece 1*, is present on one side of the sample with a contact dipping about 10-15° to the core axis. This fine-grained rock shows the same fracture pattern (mini-shatter cones?) as the sample above. On the cut surface, the margin of the fine-grained chill can be seen to 1) truncate the metamorphic fabric, 2) has rare inclusions of the adjacent rock as floating fragments, and 3) merges into the smaller shear bands that cut through the rock. This band is clearly a secondary deformation/cataclastic zone that has subsequently been recrystallized into a fine-grained, equigranular rock.

Piece 3: Bounded on two sides by vertical (relative to core axis) fracture surfaces. Amp on fracture surfaces are lineated approximately perpendicular to the core axis. More variable in grain size with some Pl (2-3 mm grain size) segregation lenses, and coarser grained Hbl (up to 2 mm). There is a 1 mm Qtz vein that dips at 40° and pinches out into an unmineralized fracture part way through the core. Another steeply dipping (~10°) < 1 mm Qtz+feldspar vein cuts across the core bottom. This vein pinches and swells and would cut the quartz vein at an angle of ~ 30-60°, but it disappears before the two intersect. Some rusty broken surfaces have a discontinuous coating of fine Py with minor Ccp. Many fracture surfaces have more abundant Pl, and one has a discontinuous coating of very fine-grained Ccp. On the inside upper fracture surface, near the patch of Ccp, there is a small patch of coarser-grained Pl and Amp that has some 1 mm Bi crystals. Disseminated Ccp also appears in areas of the rock. This Ccp is not homogeneously distributed, but is not restricted to occurring in veins.

Piece 4: A 2 cm wide piece bounded by parallel fracture surfaces. The fractures dip from approximately parallel to the core axis to approximately 15° to the core axis. There are weakly developed lineations on the fracture surfaces that vary from 80-90° to the core axis. The cut sample has a fine-grained igneous texture. There is a 5 mm-thick zone that appears to be a glassy quenched margin. There are two ~1 cm patches of intergrown euhedral Pl crystals up to 4 mm across that are glomerocrystic, but may be xenocrysts. The two glomerocryst patches are separated by a 5 mm thick shear band with abundant Fe-Ti oxide that has coarser-gained Pl along the margins. 1 mm Qtz-feldspar vein dips approximately 15° to the core axis, but at an angle of 50° (conjugate 40°) to the plane of the core breaks. A second, thinner, less continuous Qtz-feldspar vein dips at ~75° to the core axis. This vein is slightly offset by the steeper vein.

IDDP-2 Core Run 8
Loose fill (rollers)
from unknown intervals
above core



Piece A (10×10×5 cm): This piece is approximately 10 cm in diameter and 5 cm thick and was cut by the coring bit. It has rolled and it is not clear if it was cut by the bit in situ or was a large fill fragment that was cored as fill. Based on the dissimilarity to the material cored in Core Run 8, it is assumed this was a large piece of fill that was cut by the core bit as fill. This is the least altered basaltic intrusion cored to date. It is composed of about 60% elongated Pl laths that are up to 4 mm in length, 30% interstitial blocky to slightly elongate euhedral beer bottle brown Px and 5% euhedral TiMt, with about 5% finer-grained interstitial matrix of Pl/Px. Alteration is most apparent on the cut surface. There appears to be just incipient alteration of the interstitial matrix, based on the diffuse more greenish and cloudy appearance. Isolated Pl crystals in the interstitial areas are altered cloudy white, with a slight bluish-green tinge. Most of the Px is glassy clear, but some grains appear darker and may be incipiently altered to Hbl. In the interstitial areas, some Px is partially replaced by dark green Amp. A trace amount of disseminated Py occurs throughout the rock, and most of it has a thin rim of Fe-oxide alteration. Compared with the intrusive rock in Core Run 7, this sample is coarser-grained, has fresher Px, and lacks the mineral alignment in that intrusion.

Piece B (5×5×4 cm): Rounded and polished fine-grained intrusive. Slightly porphyritic to glomeroporphyritic. Elongated, felted Pl matrix with interstitial Px. It appears somewhat more mafic than *Piece A*. Pl and Px are generally about 1-2 mm, with approximately 2% Pl phenocrysts (and occasional glomerocrysts) up to 5 mm in length. There is also rare blocky to elongated Px to 3 mm that may be phenocrysts.

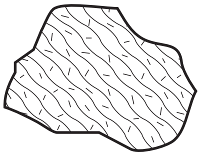
Piece C (5×4×2 cm): Relatively coarse-grained, compared to most other fragments from this core, basalt, altered to amphibole. This fragment appears to have been the most Px-rich protolith. Relict igneous texture is apparent in some areas, but not as clear as in some of the smaller fragments. Locally there is a good, lineated amphibolite texture, but generally more granular. Felsic-rich segregation layers are present and some seem to coalesce into discontinuous Qtz-feldspar veins that anastomose through the rock in various directions and merge together when they intersect. The veins contain crystals of Ccp (±Py) and trace amounts of Bi.

Piece D (4×4×1 cm): More on the amphibolite side texturally, but with only weakly developed lineation. Cut surface shows indistinct 1-2 mm darker anastomosing shear bands. The dark color seems to be due to finer grain size, not more mafic grains. However, fine-grained Fe-Ti oxide and sulfide are more prevalent in these bands. Ccp/ISS seems to be the dominant sulfide ± Py. This is the fragment that was examined on the microprobe.

Piece E (4×2.5×2 cm): Blocky fragment with weakly developed amphibolite texture. Coarser and less deformed in the center and much finer grained and more strongly lineated on some of the bounding fracture surfaces. One surface partly coated by a Pl segregation layer. There are two prominent 1 mm-thick Qtz ± feldspar veins at high angles to each other, but they are both discontinuous and do not intersect.

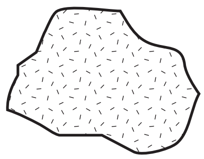
Piece F (4×2×2 cm): Wedged shaped fragment with reasonably well developed relict equigranular igneous texture in the center, and more sheared amphibolite textured surfaces. Very mafic protolith, but too much Pl for a true pyroxenite. One surface shows good mineral lineation and is more like the amphibolite. Another surface is more granular, with more abundant Pl, but also shows some lineation.

IDDP-2 Core Run 8
Loose fill (rollers)
from unknown intervals
above core



G

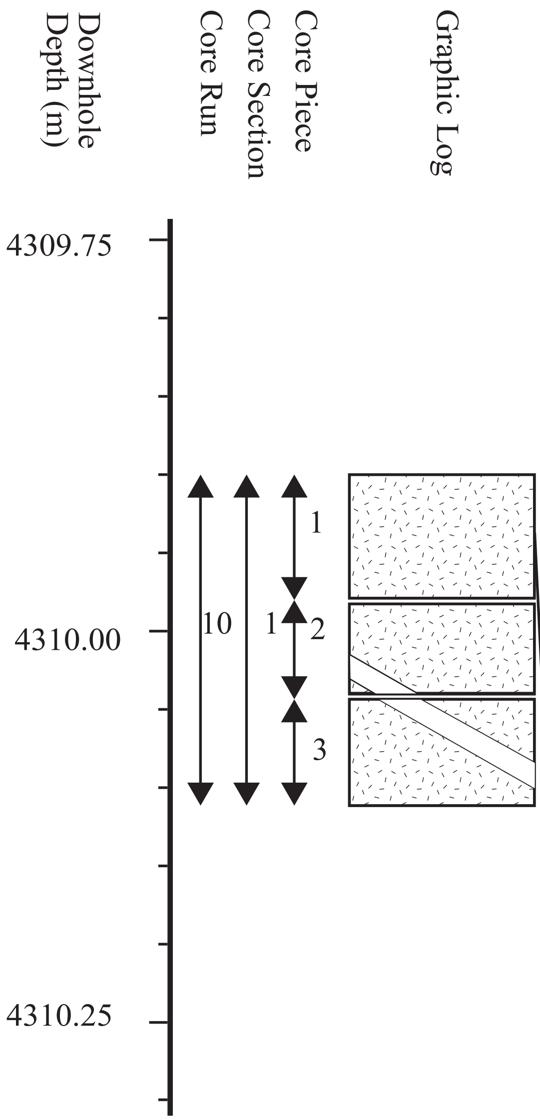
Piece G (4×2×2 cm): Small wedged shaped fragment that generally preserves an igneous texture for the interior portions, but shows more replacement and lineation on the bounding surfaces. A small portion of the sample has a surface that was cut by the drill bit. The relict igneous texture is more equigranular and coarser grained than *Piece G*, but still generally ~ 1 mm grains. Roughly 75% Px and 25 % Pl in the protolith. The fracture surfaces have more abundant Pl as the rock seems to have broken along a more felsic segregation layer. This surface may show a bit of metamorphic Bi as well. The more 'amphibolite' surfaces are rather thin and may just represent more recrystallized shear planes through the rock.



H

Piece H (4×2×2 cm): Small fragment that preserves an igneous texture. Very Px-rich fine-grained intrusive with 1 mm Px and ~ 20% Pl laths 1 mm long. Not quite a pyroxenite. Heavily altered to Amp, but only part of the rock seems to be 'amphibolite'. Cut by highly discontinuous 1 mm-wide Qtz-Pl ± pyrite vein with some Ccp.

IDDP-2 Core Run 10
4309.90 to 4310.12 m



Continued on next page

All three recovered core pieces are half rounds, as the core broke along a core-axis parallel fracture. There was no fill above the recovered core. The dominant rock type is a fine-grained basaltic intrusion with a texture suggesting emplacement as a dike, but this could be a sill. The composition is approximately 40-45% elongated tabular Pl up to 2 mm with 45-50% interstitial dark brown subhedral Px about 1 mm across, and ~7% generally anhedral 1 mm TiMt grains. The lower two core pieces contain less than 1% blocky Pl phenocrysts up to 3-4 mm and rare Px phenocrysts up to 2-3 mm. The rock is extensively, but not completely, altered. Much of the feldspar is cloudy white to light bluish-green. Phenocrysts and coarser groundmass laths are more often clear and glassy. Much of the Px is greenish due to replacement by Amp, but brown glassy Px is preserved in places. The interstitial material is completely replaced by Amp and greenish, cloudy Pl. Disseminated fine-grained anhedral sulfide is common, with Cu-Fe sulfide more abundant than Po and Py.

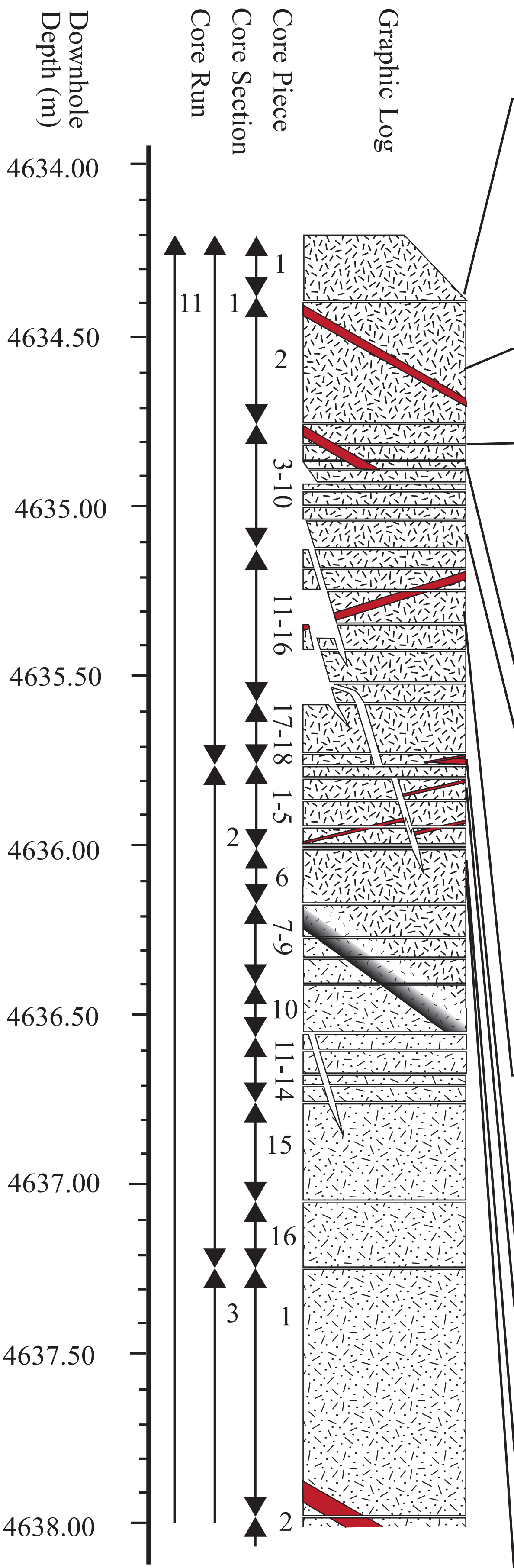
Locally, the core is cut by plagiogranite segregation veins and patches, the best developed of which is a 2 cm thick band dipping at approximately 70° to the core axis. Given the ~30° inclination of the drill hole, the vein may have originally been approximately horizontal. Where best developed, the plagiogranite is approximately 70% feldspar, most of which is anhedral and cloudy white. However, there are some euhedral, 2 mm blocky Pl crystals that are relatively clear and glassy. The plagiogranite contains approximately 20% green Amp, some or all of which likely replaces original Px. Amp has grain size range from < 1 mm, to acicular crystals < 1 mm in cross section and up to 3-4 mm long. There is ~10% fine-grained sub to euhedral TiMt disseminated through the rock. Healed fractures cutting through some of the plagiogranite may have a small amount of subhedral grey Qtz. A minor amount of disseminated fine-grained sulfide is present, mostly Cu-Fe sulfide, plus Py(?).

Piece 1: Diabasic dike (sill?) similar to the underlying two pieces, but seems to lack Pl phenocrysts, and may be more mafic and less altered than the underlying rock. The uppermost surface preserves discontinuous patches of a plagiogranite segregation vein. The contacts are not continuous enough to define a dip angle, but they are consistent with a vein dipping ~70° (which could restore to horizontal given the 30° inclination of the drill hole), similar to the vein in *Piece 2*. Relative to the vein in *Piece 2*, this one seems to have more mafic minerals. Some vuggy looking areas Qtz(?) crystals, but the morphology of the crystals is not definitive of Qtz. The uppermost surface also has some fracture surfaces that may have been a partly open fracture at depth. These surfaces have a slightly oxidized and weathered appearance, they include thin patches of sulfides that are mostly replaced by secondary Fe-oxide, and they have a discontinuous coating of asbestiform Amp that appears weathered. The Amp appears to be Act from the morphology, but the colors range from greenish to white. The greenish ones generally appear disaggregated and more crystalline, and the whiter ones are generally whisker like needles that grow into open space. A separate small fracture surface (<1 cm across in maximum dimension) is coated with small black vitreous euhedral crystals with the morphology of Px. There are relatively fewer, larger euhedral clear crystals whose morphology suggests they are hydrothermal Pl. The darker crystals were examined using oil immersion and have a refractive index well above 1.638, the morphology of Px, Px cleavage, inclined extinction at a low angle (~20°), moderate birefringence, and are moderately pleochroic from green to straw brown. The crystals are identified as hydrothermal Cpx, likely hedenbergitic with a slight aegerine component. Some crystals contain two phase fluid inclusions with vapor bubbles in the range of 25-40 volume percent.

Piece 2: Coarser-grained and more porphyritic than piece 1 with less elongated Pl. 2-3 mm blocky Pl phenocrysts appear less altered and glassy compared to matrix Pl. A 2 cm thick plagiogranite segregation vein cuts through the sample at an angle of 70° to the core axis (consistent with an horizontal vein orientation). The contact of the plagiogranite with the host rock is sharp at the macroscale, but irregular and following along grain boundaries at the microscale. There is no quenching or grain-size variation across the vein, but there is an asymmetry with the downhole margin of the vein having few mafic minerals. This zone also has only very fine-grained Mt and the feldspar appears to be more cloudy. There is a bimodal Mt grain size distribution in the rest of the vein that includes 1 mm sub to euhedral Mt crystals and finely disseminated very fine anhedral Mt. The mafic minerals also show a large variation in grain size from <1 mm crystals to 3-5 mm long acicular crystals. There are a couple of discontinuous healed fractures that cut through the plagiogranite that are slightly more porous with minor open space between grains. There seems to be some Qtz intergrown with the feldspar in these fractures. The fractures can be traced across the contact of the plagiogranite, but quickly disappear as they cross into the diabase.

Piece 3: Similar to above, maybe larger and more abundant Pl phenocrysts? The upper portion of the sample has a few 1 mm wide, poorly developed discontinuous plagiogranite segregation veins. The vertical fracture surface has abundant sulfide aggregates thinly plating the fracture surface. Cu-Fe sulfide appears to be dominant, but it appears to be intergrown with Po. There are a few very small euhedral crystals that appear to be Py, but these may be isocubanite.

IDDP-2 Core Run 11
4634.20 m to 4638.00 m



Core run 11 recovered 7.58 m of continuous core, with no missing intervals or coring gaps. Porphyritic basalt (Intrusion 1). Groundmass consists of 1 mm euhedral to subhedral glassy unaltered green-brown Cpx (65-70%) separated by 1 mm long euhedral Pl laths (20-25%). Elongate Pl phenocrysts (5%) up to 5 mm, and occasional 3 mm euhedral greenish crystals that appear to be Ol. Very rare rounded 3-4 mm anhedral clear Qtz(?). Less than 5% 1 mm euhedral TiMt (titanomagnetite). No sulfide observed. Unit appears to coarsen down core.

Section 1 Piece 1: Core piece is broken along an unmineralized fracture 20° to core axis with slickenlines aligned perpendicular to the core axis.

Section 1 Piece 2: Continuation of above. Ol phenocrysts (2-3%) with dark alteration rims and lighter serpentinized replacement in the cores are apparent on a cut surface. A prominent 2-4 mm wide Qtz + Pl vein, stained red with hematite, cuts the core 30° to the core axis. A fine-grained dark selvedge with abundant secondary Mt extends ~5 mm on either side of the vein. The core piece is intersected by <1 mm conjugate dark fractures; one set is parallel to the prominent Pl + Qtz vein and the second set is 50° to the Pl-Qtz vein. The black hairline fractures are discontinuously filled with a black mineral, probably Amp. Thin Pl + Qtz filed fractures branch off the prominent vein and crosscut the black hairline fractures, suggesting black fractures predate Pl + Qtz mineralization.

Section 1 Pieces 3&4: Two non-parallel Pl + Qtz veins stained red with hematite do not intersect in the core sample. One is a 1-2 mm wide at 60° to core axis the other is a 3-4 mm wide at 30° to core axis.

Section 1 Piece 5: Two non-parallel 1 mm wide Pl + Qtz (?) veins intersect with no offset and appear contemporaneous. One vein is 75° to the core axis the other is 30° to the core axis. The piece is broken by a fracture surface at 60° to the core axis. The fracture surface coated with biotite and is stained red with hematite. Cu-Fe sulfide and blocky euhedral hydrothermal Cpx, or possibly Amp(?), crystals are present with the biotite. The crystals are dark, blocky and elongate and appear to have 90° cleavage, but the crystal morphology resembles amphibole. (Sampled). Slickenlines on the fracture surface lie 70° to the core axis. Veins and the fracture surface continue in to Piece 6.

Section 1 Piece 10: Euhedral Cu-Fe sulfide, hydrothermal Cpx(?), and biotite are present on a fracture surface oriented 5° to the core axis.

Section 1 Piece 11: A 1-3 cm wide felsite vein is oriented 35° to the core axis. The felsite vein is 95% subhedral intergrown Pl + Qtz with about 5% mafic minerals. Mafic minerals are dominantly Px(?) partly replaced by Amp(?), euhedral TiMt up to 0.5 mm, Bi that occurs as thick booklets up to 0.5 mm across, and thin <<1 mm disseminated Bi flakes. The felsite vein contact with the wall rock is very sharp, but some euhedral Pl crystals cross the boundary. The felsite vein selvedge has abundant fine grained Mt and Bi that overprints the igneous texture and extends almost 2 cm from felsite vein edge. The selvedge is cut by several thin Pl + Qtz veins that pinch and swell to 2 mm wide and intersect the felsite vein down core. The felsite vein is stained red with a thin hematite film on the outer core edge only; the cut surfaces show no hematite staining. Cut surfaces are stained yellow and have a post-coring yellow salt precipitate that is associated with the felsite vein. The core piece and felsite vein is cut by a fracture surface that is stained red with hematite and coated with hydrothermal biotite.

Section 1 Piece 18: Piece 18 includes the third sub-vertical fracture surface, which has no slickenlines or hematite coating, but does include euhedral hydrothermal biotite and the euhedral Px(?)/Amp(?). There is a ~ 2 cm wide felsite vein that is truncated along two planes. One plane is defined by a hairline continuation felsite vein, the second plane is filled with 2 mm felsite. The wall rock at the intersection of the felsite veins is flooded with hydrothermal biotite and the euhedral Px(?)/Amp(?).

Section 2 Piece 2: A hairline Pl + Qtz vein oriented 20 ° to the core axis does not continue across the prominent fracture.

Section 2 Pieces 2 to 6: A sub-vertical fracture 5° to core axis begins in Piece 2 and ends midway down Piece 6, splitting most pieces in half. The fracture is Fe-stained in Pieces 2, 5 and 6, and is not Fe-stained in Pieces 3 and 4. A ~1 mm wide Qtz + Pl vein oriented 20 ° to core axis in Pieces 3 and 4 is discontinuous across the prominent fracture plane, and the continuation(?) is offset right-laterally by 8.5 cm along the prominent fracture.

Section 2 Piece 6: This piece broken into several discs (Piece 5 is one of these discs) along what appear to be shears oriented perpendicular to the core axis. The horizontal shears have a convex-shaped upper surface and concave-shaped basal surface. Fe-staining is concentrated on the disc surfaces where they are intersected by the fracture plane that halves the core.

Section 2 Piece 7: Weak lineations are present on the top and bottom core breaks. The breaks are parallel to each other and perpendicular to the core axis. Piece 7 has a sub-vertical fracture with similar orientation to that in Piece 6, however it does not connect to fracture in Piece 6 and is not iron stained.

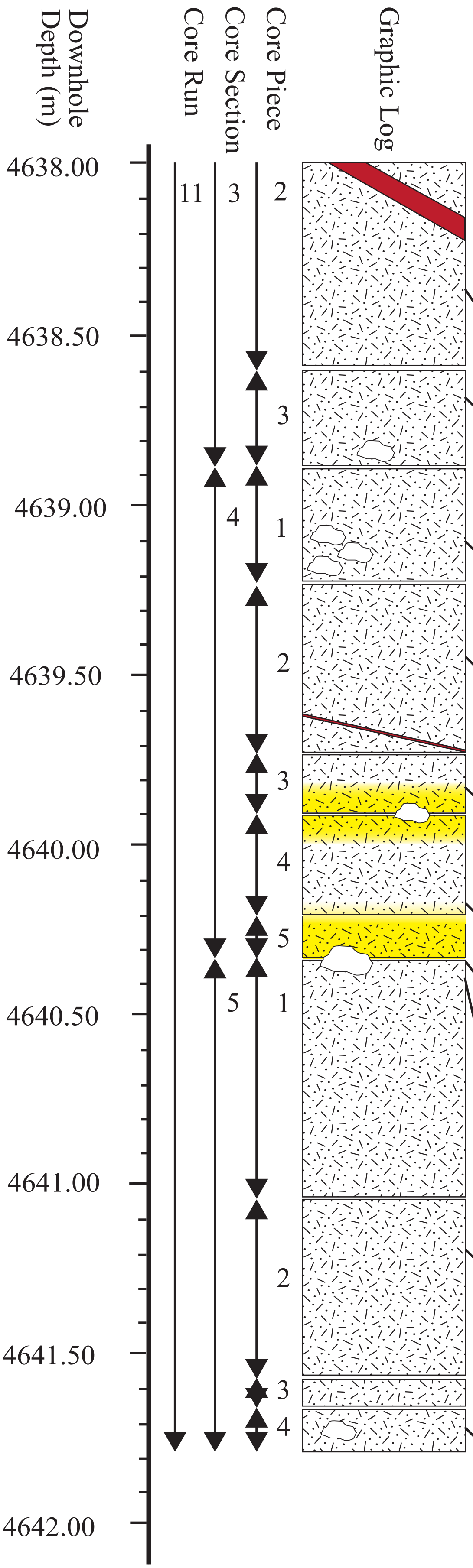
Section 2 Pieces 8 to 10: A dike margin about 20° to the core axis is present from 4636.25 to 4636.45 m. The upper dike (Intrusion 1) chilled on lower dike (Intrusion 2). In Piece 9, the chilled margin of intrusion 1 includes <1 mm wide up to 2 mm long Pl phenocrysts aligned adjacent to and along the chill, and rare <1 mm Ol phenocrysts. Three or four <1 mm wide hairline Cpx veinlets in the chill are parallel to the dike margin, and veinlet cuts these at a 40° angle. One <1 mm wide Pl veinlet is parallel to dike margin. There are <1% elongate trains of sulfide Po(?) along the chilled margin.

The lower dike (intrusion 2) has Cpx > Pl, some Pl occurs as 1-2 mm elongated crystals, more Pl is irregular shaped and forms a weakly felted matrix that is interstitial to Cpx. Some Pl has what appears to be greenish alteration in hand specimen. Cpx in intrusion 2 appears more altered than in the overlying (and younger) dike; some Cpx is blackish and some is greenish. Intrusion 2 has ~5-8% equant TiMt crystals, which appear to be more abundant than in Intrusion 1. Intrusion 2 is glomeroporphyritic with both Pl and Cpx glomerocrysts.

Section 2 Piece 12: There are sub-mm dark Cpx(?)/Amp(?) veins cutting Pieces 10, 11 and 12 at 10 ° to core axis. Pieces 11 and 12 are broken by a sub-vertical through-going fracture at about 5 ° to core axis. This fracture is coated with fine grained Bi and abundant sulfide (Po>Cu-Fe sulfide). The fracture continues into Pieces 13 and 14.

Section 2 Piece 15: Through going <1 mm subparallel dark veinlets that vary in orientation from 15 and 20 ° to core axis, and are probably mineralized with Amp. One thin vein continues into Piece 16 and is Fe-stained where the veinlets intersect.

IDDP-2 Core Run 11
4638.00 m to 4642.00 m



Overall, rock in Core 11 Section 3 is very homogenous and the core is not fragmented. This is the same dike as in Core 11 Section 2 Piece 15 (intrusion 2). The dike coarsens down hole to a maximum grainsize in Core 11 Section 5 and Core 12 Section 1, then gradually fines downhole to Core 12 Section 6 where the lower chilled margin of this dike (intrusion 2) is preserved.

Section 3 Piece 1: A through-going, 1 mm wide Pl + Qtz vein is oriented 40° to core axis, and is offset ~0.5 mm by a hairline Amp vein. There is a second discontinuous Pl + Qtz vein lower down in Piece 1. Both veins run into a prominent felsite vein at the base of Piece 1.

Section 3 Piece 2: Some <1 mm wide wispy and discontinuous dark veins that vary from sub-parallel to 10° to core axis start at about 4638.19 and continue to the base of Piece 2. A 1 cm wide Pl + Qtz with minor Bi >Px felsite vein at the bottom of Piece 1 and top of Piece 2 is oriented ~15° to the core axis extends 8 cm down-core. Large (1 mm) Bi flakes are present within the felsite, and large Bi books and flakes flood the wall rock adjacent to the felsite. The vein contains brecciated wall rock fragments, one of which is 1 cm wide. The core broke along or near both sides of this felsite vein. The uppermost of these fractures, just described, is not coated with the otherwise ubiquitous hematitic stain, suggesting the core broke along this fracture during removal from the core barrel.

Section 3 Piece 3: A very wispy vein at 4638.15 disappears down core at 4638.30. A 1-2 cm long irregular shaped Pl-rich segregations is present near base of Piece 3.

Overall, rock in Core 11 Section 4 is very homogenous and the core is not fragmented.

Section 4 Piece 1: Some irregular shaped Pl-rich patches up to 0.5 mm wide by 10 mm long are present around 4639.10.

Section 4 Piece 2: A 1 mm wide white Pl vein oriented 40 ° to core axis starts at 4639.62 and ends at the base of the core piece.

Section 4 Piece 3: Yellow staining starts at 4639.74 in Piece 3, ends at about 4640.00 m in Piece 4, and is concentrated around the core break at 4639.90. The bottom of Piece 3 and top of Piece 4 have irregular-shaped Pl-rich white segregation patches and 1-2 mm wide Pl-rich veinlets that are discontinuous up core, but continue down core into Piece 4.

Section 4 Piece 4: Weak, faint yellow stain starts ~2 cm above the Piece 4/Piece 5 break and is present on all of Piece 5.

Section 4 Piece 5: Another irregular shaped 4 cm by 3 cm Pl-rich patch is present on the base of Piece 5. The patch includes 2 mm Bi and black Px, with Px>Bi.

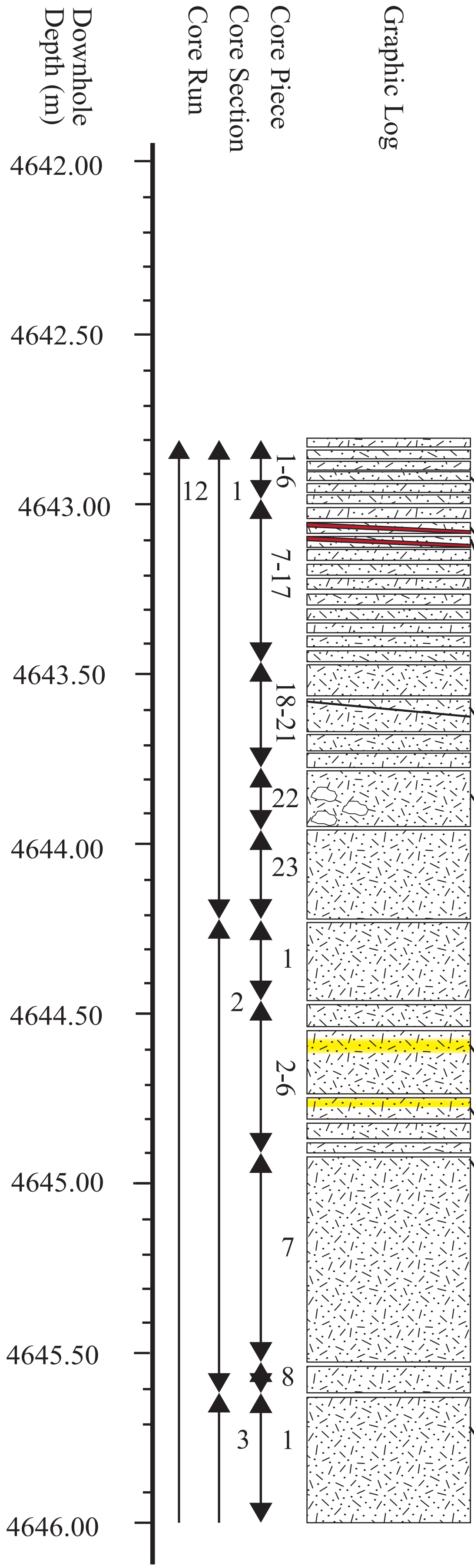
Overall, rock in Core 11 Section 5 is very homogenous and the core is not fragmented.

Section 5 Piece 1: Top of Piece 1 has a continuation of the felsite patch from base of Section 4 Piece 5. The patch extends ~3 cm down core and is about 4 cm wide and extends up to 2 cm into core. Another small, ~ 1 cm, irregular felsite patch is present at 4640.85 m.

Section 5 Piece 2: A 1 mm wide discontinuous Pl vein starts at 4641.17 m and is oriented 70° to the core axis.

Section 5 Piece 4: Contains an irregular-shaped 1 by 2 cm felsite patch.

IDDP-2 Core Run 12
4642.80 m to 4646.00 m



Core 12 Section 1 is fragmented and broken into 'discs', probably drilling induced based on the absence of mineralization or shear fabric on the breaks. From 4642.8 to ~ 4643.43 the core is speckled with a very faint Fe stain that is not present on cut surfaces.

Section 1 Piece 3: Three fragments that fit together and are split by an unmineralized subvertical plane ~parallel to the core axis. One thin < 1 mm wide Pl + Qtz vein is oriented 70° to the core axis.

Section 1 Piece 8: One 3 mm wide through-going Pl + Qtz vein is oriented 70° to the core axis.

Section 1 Piece 9: One 1 mm wide through-going Pl + Qtz vein is oriented 60° to the core axis.

Section 1 Piece 19: One < 1 mm wide Pl + Qtz vein is oriented 80° to the core axis.

Section 1 Pieces 16 to 23: Irregular-shaped Pl-rich patches up to 5 cm start at ~4643.53 to base of Core 12 Section 1; prominent patches at 4643.85, 4643.93, and 4644.00.

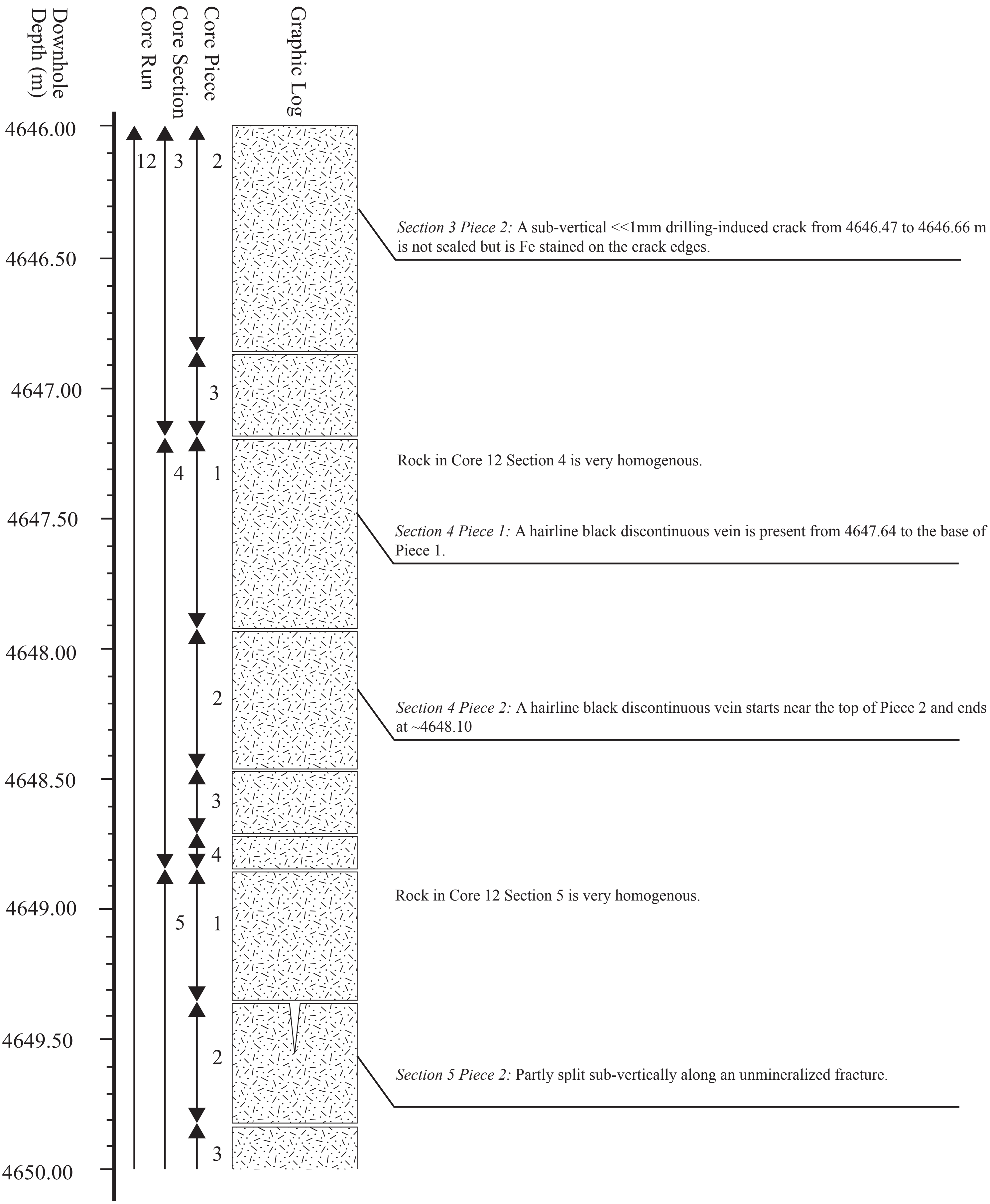
Section 2 Piece 3: Very weak yellow staining and a non-continuous <1 mm wide Pl vein oriented 55° to the core axis at 4644.56 m.

Section 2 Piece 4: ~2 cm interval of very weak yellow staining at the top of Piece 4 (4644.75 m).

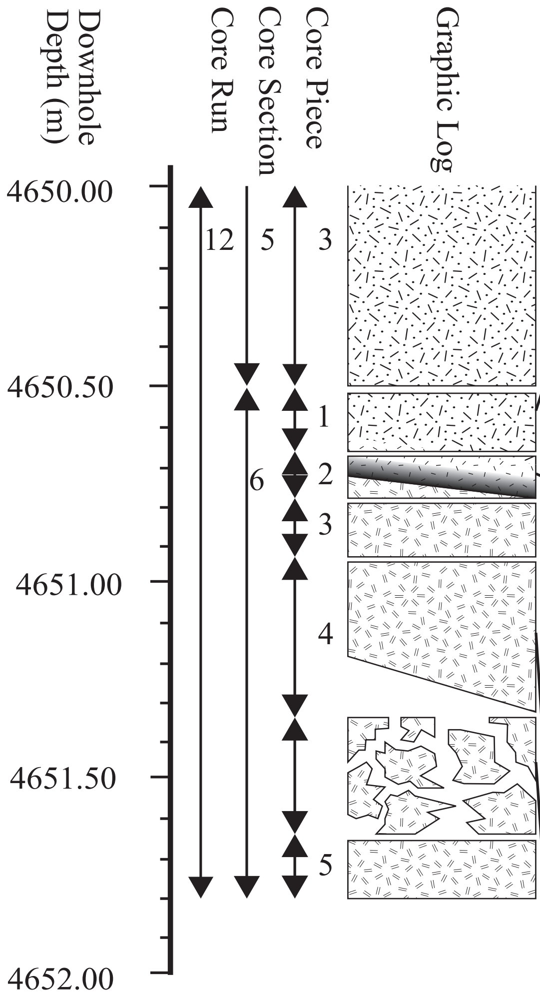
Section 2 Piece 7: Starting from 4644.90 down core rock is fairly homogenous.

Section 3 Piece 1: < 1mm wide Pl vein subparallel to the core axis from ~4645.62 to ~4645.90

IDDP-2 Core Run 12
4646.00 m to 4650.00 m



IDDP-2 Core Run 12
4650.00 m to 4651.80 m



Section 6 Piece 1: Two sub parallel discontinuous <1 mm wide Pl veins are oriented 60 ° to the core axis.

Section 6 Piece 2: A chilled margin at ~35 ° to core axis indicates the upper dike (intrusion 2) chilled on the lower dike (intrusion 3). Pieces of the lower and older dike are broken off and included in the quenched margin. The chilled margin is irregular and not planar because of fragmentation of the lower dike. A ~5 mm wide 'dikelet' extends about 5 cm into lower and older rock. The quenched margin is cut by 1-2 mm wide highly discontinuous Pl-rich veins with Px > Mt and trace Bi. There are sparse elongate Pl microphenocrysts in the quench that are up to 2 mm long and are not aligned along the dike margin. Rare (at least one) rounded unaltered Px phenocrysts are present in the quench.

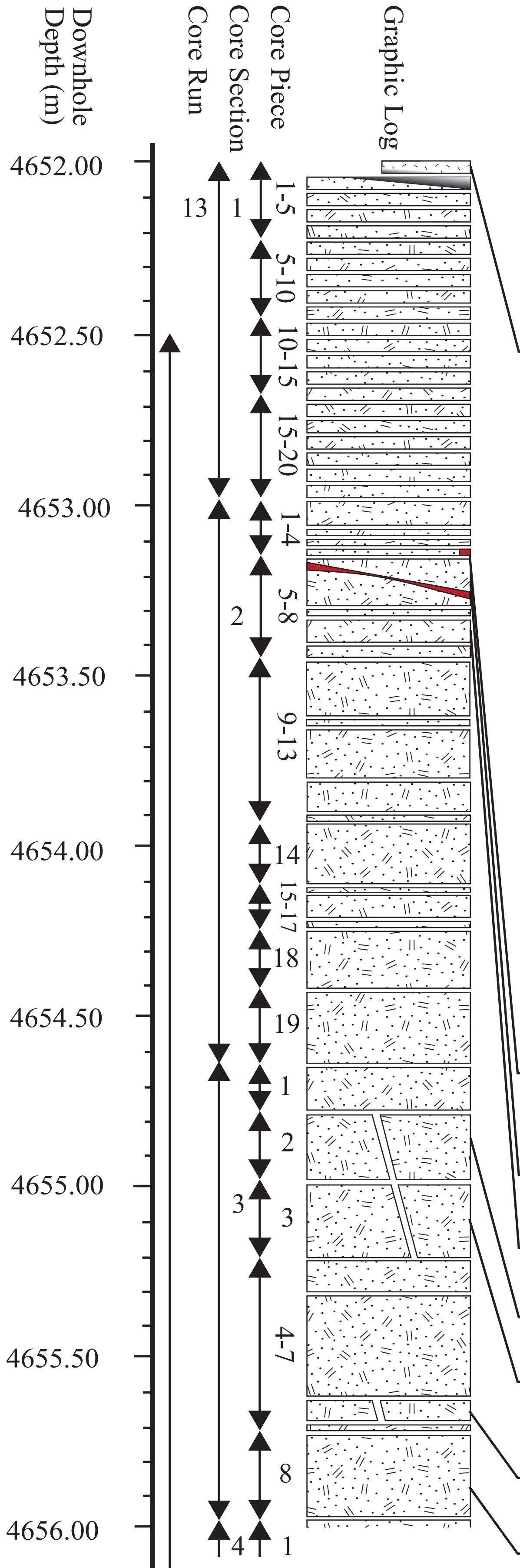
Intrusion 3 (the lower, older intrusive in this core section) has a heterogeneous texture, and is a medium to fine grained intrusive. The rock is texturally heterogeneous with patches that are coarser, finer, or richer in interstitial material. There may be a subtle grainsize decrease downcore from the chilled contact to the bottom of Core 12 Section 6. Based on hand sample observations this intrusion is classified as a two-Px diabase. The dominant texture consists of 2-3 mm elongate Pl (55%) with occasional pheno/glomerocrysts of blocky Pl up to 4 mm. All Pl is generally clear and appears unaltered. Cpx (15%) appears as blocky, black, 2 mm euhedral crystals that are rarely elongate, up to 4 mm. Opx (20%) is beer bottle brown, euhedral, and 1-2 mm. Patches of fine-grained, late-stage interstitial material make up 7-8% of the rock, and consist of concentrated irregular shaped 5-10 mm patches of fine-grained Pl, Opx, and Cpx that appear slightly greenish and slightly altered. There are occasional 1-2 cm patches of coarser grained rock with the same composition. There is patchy overprinting alteration where some of the Px is altered to Amp, but other patches where all crystals appear fresh. Ti-Mt (2-3%) is fine grained and not abundant in coarse grained patches, but occurs as fine grained aggregates in the fine grained interstitial material, and often occurs with sulfide (Po?).

The lower (older) two pyroxene dike is less magnetic than the overlying dike rocks. The outer surface of the lower dike is strongly stained by yellow-orange Fe-oxide. The orange staining is locally overgrown by yellow salts that leached out and precipitated post-drilling. Pre-and syn-drilling through-going fractures are Fe-stained, while core surfaces from fragmentation that occurred during removal of rock from the core barrel are fresh. Fe-staining is usually only a surface coating. The intensity of Fe-staining increases downhole to orange-red Core 13 Section 1, then decreases again to yellowish orange midway down Core 13 Section 3. After being cut and wet, the drying core rapidly precipitates yellow potassium-iron-chloride salts from the rocks in the interval below the chilled margin in Core 12 Section 6 through to the deepest rocks cored that were recovered at the base of Core 13. The intensity of yellow salt precipitation is coincident with the intensity of Fe-staining on the outer surface of the core.

Section 6 Piece 4: A red-stained fracture that terminates the base of this core piece and is oriented 50° to the core axis. Two of the fragments lower down in the interval of fragmented core are split by an unmineralized fracture oriented ~60 ° to core axis.

4651.64 to 4651.80: Interval of highly fragmented core. Some fragments have outer edges cut by the drill bit.

IDDP-2 Core Run 13
4652.00 m to 4656.00 m



Fe-staining on Core 13 is pervasive, but is only a surface coating. When the core is broken into discs, disc tops and bottoms are strongly Fe-stained but the interior is not Fe-stained when cut with a rock saw. Fractures that define the top and bottom surface of the discs are assumed to be drilling-induced, as the surfaces are unmineralized and there is no grain size, textural, or mineralogical change towards disc centers.

Section 1 Piece 1: A chilled margin is present on the top Piece 1, which has no blue/red orientation marks. The uppermost piece in the box (as shown on the core scan and described here as Piece 1) is a half-disc that fits exactly onto the bottom of the underlying core piece (described here as Piece 2). If the blue/red orientation marks on Piece 2 are correct, then Piece 1 is out position in the core box. If the Piece 1 is in the correct position, then the blue/red orientation marks on Piece 2 are incorrect (the situation indicated on this log). Both Piece 1 and Piece 2 have a chilled margin quenched against a coarser-grained intrusive. If the position of the core pieces in the core box is correct, it implies the overlying dike in Core 12 Section 6 (intrusion 3) chilled against an older intrusion (intrusion 4) in Core 13 Section 1. If the blue/red orientation marks on Piece 2 are correct, it suggests the dike in Core 13 Section 1 (intrusion 4) chilled against intrusion 3 in Core 12 Section 6. The age relationship is equivocal based on a comparison between the texture and mineralogy of the over- and under-lying dikes, but may be confirmed by more detailed observations made on thin sections.

Intrusion 4 is characterized by a heterogeneous texture and composition with patchy alteration. Euhedral Pl (60 to 65%) forms a matrix of thin, elongated and felted crystals 2-3 mm long, with 30% 1-2 mm interstitial dark Cpx, and 5-8% 1-2 mm subhedral TiMt. There is patchy development of coarser, blocky to glomerocrystic Pl up to 3-4 mm. Pl appears generally fresh, but Px is partly altered to Amp.

From the top of this dike (Core 13 Section 1 Piece 2), the unit may coarsen down hole, but potentially becomes finer grained again towards the lowermost part of Core 13. Variation in grain size is difficult to discern due to the ubiquitous Fe staining. Diffuse, centimeter-scale clots of coarser-grained material appear throughout the dike and are separated on the scale of centimeters (a 10 cm length of core may contain two to four cm-sized clots) giving the cut core a spotted appearance. The boundaries of the clots are indistinct and gradational and may suggest partial assimilation or magma mixing/incorporation of crystal mush. The coarser-grained clots tend to have slightly more Px, and the Pl and Px can approach 4 mm in size. Many of the coarser-grained clots contain relatively clear Pl, but there are clots where the Pl has a cloudy appearance. Throughout the dike there is patchy development of alteration characterized by cloudy interstitial material around relatively clear Pl laths. The cloudy appearance may be due to disseminated Ttn and some of the cloudy Pl has a faint pink to orange color. Millimeter-scale pseudo-veins crosscut the core and are defined as thin zones of cloudy Pl that cross-cut the igneous fabric. Fine-grained sugary textured mm-wide Feldspar-rich + Qtz(?) zones with indistinct boundaries may represent healed fractures or thin zones thermal recrystallization.

Orange staining is locally overgrown by yellow salts that leached out and precipitated post-drilling on all rocks from Core 13 Section 2 and below.

Section 2 Piece 4: A ~3 cm diameter patch is a fragment of felsite vein at a high angle to the core axis that is plastered to the side of the core.

Section 2 Piece 5: A felsite vein up to 3 mm wide locally pinches down to almost zero, and is oriented 10° to the core axis. The vein contains minor elongate Cpx and fine Mt, and seems to have a darker more Mt-rich selvedge.

Section 2 Piece 7: The top surface of Piece 7 has a mm-scale thick shear plane with lineations perpendicular to core axis.

Section 3 Piece 2: Core piece split in half along an unmineralized fracture plane oriented ~20 ° to the core axis.

Section 3 Piece 3: A through-going unmineralized fracture cracks core piece from top to 4655.10 along an open fracture stained with Fe along the crack edges.

Section 3 Piece 6: Core piece split in two along a fracture plane sub parallel to the core axis.

Section 3 Piece 8: A wispy, discontinuous 1 mm wide Pl + Qtz vein oriented sub-vertical to 5° to the core axis along the length of the core piece trends into Core 13 Section 4 Piece 1.

IDDP-2 Core Run 13
4656.00 m to 4657.64 m