Diamond Shamrock
Thermal Power Company

CORE DESCRIPTION
40 FOOT INTERVAL

HOLE CTGH-1
FIELD CASCADES/CLACKAMAS

GEOLOGIST (S) GOODWIN/McDANNEL
BASIS BINOCULAR MICROSCOPE DATE 8/18/86

DEPTH INTERVAL	DESCRIPTION
4797	BASALTIC ANDESITE (A/A)
	4796- VOLCANIC BRECCIA (a/a @ 4784')
	Med gry – med dk gry. V. light Znclay mineralization
	Green Clays & zeolites a/a.
4817	
4837	

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Thermal Power Company

CORE DESCRIPTION
40 FOOT INTERVAL

HOLE CTGH 1 GEOLOGIST (S) MCDANNEL/GOODWIN
FIELD CASCADES/CLACKAMAS BASIS BINOC. MICROSCOPE DATE 8/18/86

DEPTH INTERVAL	DESCRIPTION
4757'	

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BASALTIC ANDESITE (A/A)

4742'-4767½' VOLCANIC BRECCIA (continued)
and 2ndary min. deposition in fracs & voids light. Clays are predominate material in <1mm voids (vesicles & matrix) & wht fibrous radiating zeolite is most abundant in >1mm vesicles & cavities. Cavities (≤40mm) contain clays (grygrn, lt. blue, med olive grn, blue gry) +/- mnr. pale blue silica +/- med. blue gry finely spheroidal zeolite?/clay? +/- clr drusy zeolite +/- wht brittle film (=silica + clay?) +/- wht fibrous zeolite +/- soft brngry clay. From 4763'-4765½': dense b-a. block w/mnr. breccia texture, cmn. frac @45° w/grn + brn clays +/- wht brittle film.
Contact is gradational.

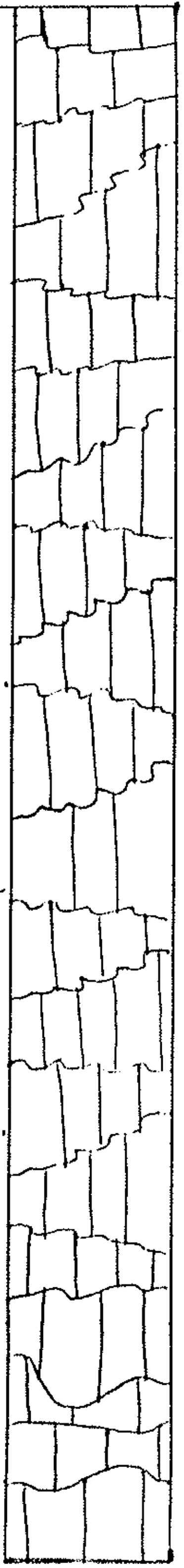
4767½'-4784' BASALTIC ANDESITE LAVA
DK gry to med. dk gry, aphyric, dense, & brittle. Top 2' has vesicles & cavities stretched along sinuous subvertical planes (≤50mm, commonly <5mm, 5-15%). These voids are ptlly lined or completely filled (smaller voids only) with gry grn clay +/- clr (or stained yellow by FeOx) drusy zeolite +/- mnr. pale blue silica +/- soft brngry clay. Below 4769½', unit is dense & brittle w/o vesicles. Fracs. are common with a variable ∠ but most commonly @ 40°-70° (+ local sinuous subvertical frac.). Fracs. are stained by red brn FeOx and coated w/ gry grn & mod. yel. brn (waxy) clays. FeOx stains in bands (≤40mm) and spots (mod red brn, dusky yellow, dusky red) become common below 4775' and may also color clays. Sharp irregular contact @ base.

4777'

4784'-4790' VOLCANIC BRECCIA
Dk gry - red brn. Abrupt but transitional contact w/above unit. Breccia is slightly scoriaceous. Secondary mineralization is light. Green & blue green clays are most common secondary material. Light amt of zeolites (as described above). Silica is present in v. light amounts & rarely forms well terminated quartz crystals as fine drusy lining on voids. Clays & zeolites occur in small (commonly ≤1mm, but up to 5mm) voids.

4790-4796' BASALTIC ANDESITE (LAVA FLOW)
Med gry, aphyric, vesicular. Vesicles & veins are typically flattened & may be as large as 5cm. Smaller vesicles filled w/clay & commonly silica or zeolites is above clay. (Clays are grn, blue grn a/a). Larger voids filled by silica. Rare botryoidal silica. Fills fractures also. Alteration decreases w/ depth as unit becomes denser @ 4794.5'.

4797'



Diamond Shamrock
Thermal Power Company

CORE DESCRIPTION
40 FOOT INTERVAL

HOLE CTGH1
FIELD CASCADES/CLACKAMAS
GEOLOGIST (S) McDANNEL / GOODWIN
BASIS Binoc. Microscope DATE 8/17/86

DEPTH INTERVAL	DESCRIPTION
4717'	BASALTIC ANDESITE (A/A)

4707' - 4730.5' VOLCANIC BRECCIA

partially to completely with clays, zeolites and silica. Clays are predominate in the < 2mm voids and silica & the white fibrous zeolite in the cavities. A common rim → interior cavity lining sequence is: dusky blue grn +/- grn gry +/- lt. blue +/- dk. olive gry clays → clr. foliated zeolite or pale blue botryoidal silica (opalescent) → wht radiating fibrous zeolite. Secondary mineralization is commonly light and rock alteration very minor. Silica is much less common than zeolites.

4730.5' - 4732' BASALTIC ANDESITE (LAVA FLOW)

Gradational contact w/above unit. Lava flow is thin & very vesicular. Typically voids are lined w/ lt blue grn clay; w/dusky grn clay filling bottom of void (vesicle) & zeolite or silica overlying clays.

4731'

4732' - 4738' VOLCANIC BRECCIA (A/A @ 4707')

Gradational contact. Dense. Secondary mineralogy same as breccia @ 4707'

4738' - 3742' BASALTIC ANDESITE (FLOW)

Gradational contact. Upper 3' of unit are vesicular. Vesicles filled w/dusky green clays. Blue grn clay less common & may thinly line vesicle walls. Clays are typically overlain by wht zeolite or silica, with silica predominate. Minor v. fine clear dusky zeolite lines some vesicle walls. Unit is fractured but consolidated w/silica filling fractures & voids. less commonly, grn clay in fractures.

3742' - 3767½' VOLCANIC BRECCIA.

med to dk gry lapilli-sz v.f.s (with rare blocks) in red brn ash-sz v.f. matrix - all basaltic andesite. Local common grn tinge from grn gry clays filling common sm. vesicles in v.f.s & sm. matrix voids (< 1mm). Rare fractures (eg @ 4758' with frac's @ 0° to 15° & lt. amt. 2ndary coatings of grn gry clay +/- med. blue gry botryoidal clay +/- pale blue (?) botryoidal) silica. Overall moderate to

4757'

CORE DESCRIPTION

40 FOOT INTERVAL

HOLE CTGH 1
FIELD CASCADES/CLACKAMAS

GEOLOGIST (S) MCDANNEL/GOODWIN
BASIS BINOC. MICROSCOPE DATE 8/17/86

DEPTH INTERVAL

DESCRIPTION

4677'

BASALTIC ANDESITE (A/A)

4658.5'-4694.5' VOLCANIC BRECCIA (continued)
soft brngry clay. Vesicles are commonly ≤ 2mm. Cavities are intermittent and ≤ 20mm. Cavity filling is similar to vesicles exc. pale blue (± botryoidal) silica is common on clays lining voids. The white fibrous (radiating) zeolite is the most common cavity fill material and generally occurs on the interior except @ 4688' where a dusky yel grn v. fine spheroidal clay?/zeolite? is present. While cavities are partially filled, vesicles (≤ 2mm) range from completely filled to barren & often are partially filled - most commonly with gry grn clay, giving the rock a grnish tinge. Basal contact is gradational.

4694.5'-4707' BASALTIC ANDESITE LAVA
med. dk. gry, aphyric to v. finely phaneritic, dense, intermittent vesicles (0-15%, ≤ 25mm & commonly < 2mm) above 4703', below 4703' rock is dense w/ incipient partings @ 45° @ 4704' and platey fracture @ 4704½' for 6" interval. Below platey fracture @ 90°, common fracture attitude is @ 15° to 45°. In the fractured interval FeOx-stained, lightly-sheared clays (mod. red brn, lt. olive brn + intermittently waxy) are present in v. lt. amts on fracs. (& in matrix/grdmass same color clays are present in v. lt. amts, unsheared). In upper unit fracs. are less common and irregular, most commonly @ vertical (sinuous) & 45°. These fracs. have v. lt to mod. amts. v. pale grn clay or dk gry grn clay ± pale blue silica (as unlets & vns to 6 x 60 mm max.) vesicles contain pale grn, dk gry grn, lt blue, gry olive grn clays ± clr to pale blue silica ± clr drusy zeolite ± wht fibrous (locally chalky) zeolite ± gry grn botryoidal clay?, silica and clays are the predominate cavity/vesicle fillings. Contact is gradational in frac'd interval and overall 2ndary material is light.

4697'

4707'-4730.5' VOLCANIC BRECCIA
A/A @ 4658.5', fractures are rare @ 60°-80° with v. dk red brn stain ± gry grn clay. Rock is dense with fine (< ½mm) matrix voids and commonly vesicular r.f.s. Vesicles/cavities are filled

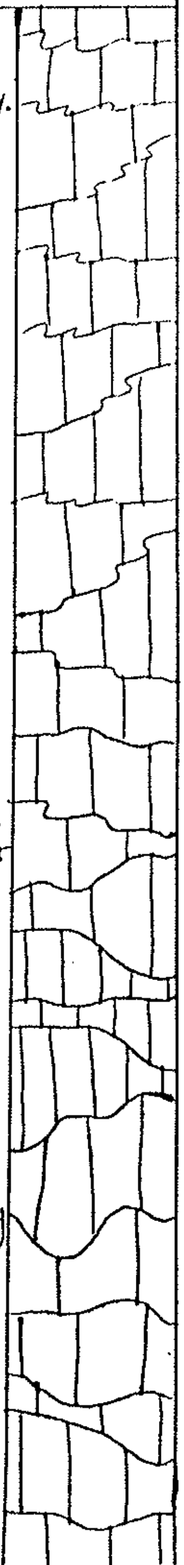
4717'

A L A L A L A L H M H A L A L A L A

CORE DESCRIPTION
40 FOOT INTERVAL

HOLE: CTGH 1
FIELD: CASCADES/CLACKAMAS
GEOLOGIST (S): McDANNEL/GOODWIN
BASIS: binoc. microscope
DATE: 8/16/86

DEPTH INTERVAL	DESCRIPTION
4637'	A — BASALTIC ANDESITE (A/A) 4630'-4636' BASALTIC ANDESITE LAVA (continued) med. dk gry, aphyric, dense, lt. frac. @70° w/ dk red brn film/stain, ± grn clay. fracs less common @ 30° & 45°. 2ndary mins. concentrated in top 1½', vesiculated lava. Vesicles rarely 10mm, commonly ≤ 3mm, 4-10% above 4632'. Silica is predominate. Linings include yel. gry, gry grn, & blue gry clays, clr drusy zeolite & pale blue (½ botryoidal) silica. 4636'-4649' VOLCANIC BRECCIA Gradational contact w/above unit. Med-dk gry. Dense, few lapilli w/vesicles. Alteration is pervasive but light. Clays & zeolites fill small (<2mm) voids. Clays are predominate & include grn, blue grn & lt blue (may be botryoidal) & black (actually is very dark grn). Most common zeolite is white, fibrous 4649'-4658.5 BASALTIC ANDESITE (FLOW) Gradational contact. Lava is dense, aphyric. Green clays common throughout rock & often replace mafic minerals. Sparse, small (≤5mm) vesicles are lined with clay, which may be coated with silica. ~3cm void near contact filled w/ v. pale blue silica. Mnr, sometimes brittle, grn & blue "clay" on fracture surfaces, & may show minor shear. Dusky red "hematitic clay" also on fracture surfaces & shear.
4657'	L — A — L — A — L — A — L — M — A — L — A becomes common by 4652', accompanying blue & grn clays. Lt. green, shiny soft clay on shear surface. Fracturing is low angle (horizontal to 75°) &, less commonly, vertical. 4658.5-4694.5' VOLCANIC BRECCIA Gradational w/above unit. Med gry - red brn. Generally dense (minor vesicular lapilli). Lt blue clay appears most common secondary mineral but is not abundant. Alteration light. Grn clays, blue grn clays; foliated drusy, & fibrous zeolites. Vesicles commonly lined/filled in this order (vesicle wall → interior): dk grn or blue grn clay / lt green / drusy or foliated zeolite / fibrous zeolite. Mnr. black clay, mnr. silica (more common with depth), mnr.
4677'	



Diamond Shamrock
Thermal Power Company

CORE DESCRIPTION
40 FOOT INTERVAL

HOLE CTGH-1
FIELD CASCADES/CLACKAMAS
GEOLOGIST (S) MCDANNEL/GOODWIN
BASIS BINOC. SCOPE DATE Aug 15, 1986

DEPTH INTERVAL	DESCRIPTION
4597'	BASALTIC ANDESITE (A/A)

4596'-4616' VOLCANIC BRECCIA
Med-dk gry, red brn. Breccia is vesicular & has a more open texture than breccia @ 4553'. Secondary mineralization light & includes grn & blue grn clays, wht zeolite (fibrous). Fracturing is uncommon with nnr and @ ~45° (sinuous) without 2ndary min. deposition. Vesicles are ≤ 6mm in size and commonly ≤ 3mm and rarely completely filled except when silica is the most recent cavity filling. All vesicles/cavities generally have a light coating of gry grn clay +/- the following materials toward the interior: +/- lt. tomed. blue clay +/- gry botryoidal zeolite +/- clr drusy zeolite +/- wht radiating acicular zeolite. The wht zeolite is predominate in this sequence. Silica rarely occurs with any zeolite except the wht acicular zeolite and is also common.

4616' - 4620' BASALTIC ANDESITE LAVA.
4617' med dk gry, dense, aphyric to v. sparsely porphyritic with plag & pyx. phenos., Rare fracturing is @ 45° and irregular. No 2ndary material is present on fractures. Vesicles are ≤ 10 mm in size and commonly < 1mm. Again clays initially rim vesicles followed by zeolites and/or silica. Silica and the wht acicular zeolite (Natrolite?) are predominate and overall 2ndary mineralization is greater than preceding breccia though still light. A common vim → interior sequence of vesicle filling materials is: gry grn clay +/- lt. blue clay +/- pale blue botryoidal zeolite (more opaque than the commonly opalescent silica) +/- pale blue botryoidal silica +/- clr drusy zeolite +/- wht acicular (radiating) zeolite (locally chalky).

4620'-4630' VOLCANIC BRECCIA
A/A @ 4596'. Fracs virtually absent +/- nnr FeOx red brn stain. Cavities, as in the preceding lava, are ≤ 10mm with < 2mm vesicles more common. Cavities and vesicles are commonly partially filled w/ linings or bands of 2ndary mins as described above @ 4616'. Silica may completely fill vesicles but zeolites rarely do. Clays include gry grn, blue gry, blk, & yel. gry. Alteration remains light.

4630'-4636' BASALTIC ANDESITE LAVA
4637'

CORE DESCRIPTION

40 FOOT INTERVAL

HOLE CTGH-1
FIELD CASCADES/CLACKAMAS

GEOLOGIST (S) GOODWIN/MCDANNEL
BASIS BINOC. MICROSCOPE DATE Aug. 15, '86

DEPTH INTERVAL	DESCRIPTION
4557'	ALLUVIAL
	BASALTIC ANDESITE (A/A)
	4553'-4565' VOLCANIC BRECCIA (cont'd)
	Dense med to dk gry. Blocks & lapilli of aphyric - sparsely porphyritic (dense to vesicular) basaltic andesite in minor matrix of basaltic andesite lava. Green & blue green clays commonly line vesicle walls & are overlain by zeolites (clear drusy, v. pale blue botryoidal, fibrous). Fibrous, white zeolite is last 2nd day mineral to be deposited. Silica fills vesicles locally. Black (actually v. deep green when disaggregated) clay (may) fills vesicles lined by green clay beginning @ 4559'.
	4565'-4571' BASALTIC ANDESITE (LAVA FLOW)
4577'	Gradational contact w/above unit. Lava is aphyric, med to med dk gry. Vesicular near top but quickly becomes dense. Vesicles are lined or filled w/grn & blue grn clays, & (commonly) may be overlain by zeolite (drusy, fibrous) or silica. Lt. coating of blue grn clay on fracture surfaces. Fracturing generally is light & is oriented vertically, horizontally & rarely 30°. ("Black" clay, a/a, also common).
	4571'-4591.5' VOLCANIC BRECCIA
	a/a @ 4553', but w/ larger number of vesicles/void spaces. Grn clays, a/a, fill or coat vesicle walls. Clay generally is light in this interval. Zeolites common, particularly white fibrous one (is dominate). Appearance of gry clay & grey blue clay, typically thin brittle coating. Grey blue may be botryoidal. Fracture is horizontal ± sub-horizontal.
	4591'-4596' - BASALTIC ANDESITE (LAVA FLOW)
4597'	Gradational contact w/above unit. Flow is dense, aphyric. Sparse vesicles lined/filled w/green & "black" clay; typically accompanied by white zeolite or silica

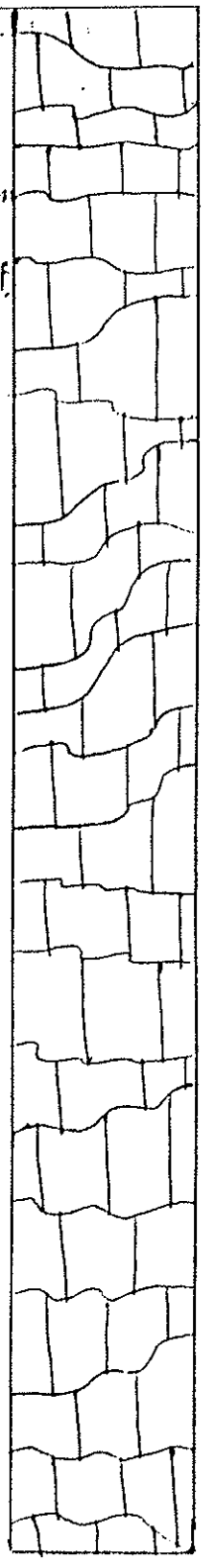
CORE DESCRIPTION

40 FOOT INTERVAL

HOLE MTGH-1 GEOLOGIST (S) McDANNEL / GOODWIN

FIELD CASCADES / CLACKAMAS BASIS BINOC. MICROSCOPE DATE Aug. 14, '86

DEPTH INTERVAL	DESCRIPTION
4517'	4515' – 4519' BASALTIC ANDESITE FLOW Dk gry-med gry, dense. Gradational contact with above unit. aphyric. Sparse ≤20mm vesicles (stretched @ 0° to 95°) in top 1'. Lt. to mod. frac.-irreg. @ 45° to 90° w/ lt. shear film of red brn FeOx +/- dk gry grn clay. Parting @ 90° + 0° w/ inlets of frac.-fill material. In ≥5mm cavities pale blue silica predominate. In smaller vesicles lt. grn clay +/- silica. Base is sparsely porphyritic w/ 2-3% plag. phenos. Sharp brecciated contact. 4519' – 4529' VOLCANIC BRECCIA (BASALTIC ANDESITE) brn gry & med gry b.a. lava lapilli-and, less commonly, block-sized r.f. in mod. red brn ash-sized matrix of b.a. r.fs, r.f. & common grn tinge due to abundant gry grn clay in common sm. (≤1mm) irreg. matrix vesicles. Fracs. lt. to absent with most common at 45°-70° with red brn FeOx stain. Vesicles are commonly ≤5mm and lined with clay, zeolites, and silica. Partial-to complete vesicle fillings from rim → interior include: v. lt. gry/clr botryoidal (+/- dusty) zeolite +/- dk olive grn/blue grn/grn gry clays +/- v. fine disseminated grn stumpy zeolite w/ prismatic habit +/- clr (locally brn stain) foliated zeolite +/- rare wht acicular zeolite +/- pale blue (+/- botryoidal) silica +/- yel gry clay. Clays → foliated zeolite + wht acicular zeolite, or clays → silica are most common linings/fillings.
4537'	4529' – 4553' BASALTIC ANDESITE LAVA med dk gry, aphyric. Top 13' is transitional with intermittent narrow breccia intervals. Commonly vesicular to 4548' (2-25 mm, commonly hor. elongate, 2-15%) with increase in 2ndary mins due to available pore space increasing. Pvt. to complete vesicle and cavity fillings of gry gry clay + pale blue silica + wht acicular zeolite are most common. 2ndary material in linings & horizontal bands includes: clays (gry gry, blue gry, olive gry, yel gry, blk) +/- clr foliated zeolite +/- pale blue botryoidal silica +/- wht radiating fine needle zeolite. Silica is most abundant 2ndary material. Rare limonite (yellow to red) oxidation bands (2mm wide) in matrix adjacent to fracs. Fracs. v. lt. with variable ∠ but 45° most common. Mnr film FeOx brn to gry-gry grn clay w/ lt. shear on fracs. @ 4532': nice silica stalactites. @ 4540'-4542' nice acicular & foliated zeolites w/ 2mm xtals (Big!).
4557'	4553'- 4565' VOLCANIC BRECCIA (BASALTIC ANDESITE)



Diamond Shamrock
Thermal Power Company

CORE DESCRIPTION

40 FOOT INTERVAL

HOLE: CTGH-1 | GEOLOGIST (S): GOODWIN/MCDANIEL
FIELD: CASCADES/CLACKAMAS | BASIS: BINOC. 'SCOPE | DATE: 8/14/86

DEPTH INTERVAL	DESCRIPTION
4477'	BASALTIC ANDESITE (A/A) (cont'd from pg. 99)
	‡, less commonly, clear drusy zeolites fill voids ‡ vesicles
	4477'-4490' BASALTIC ANDESITE FLOW
	Gradational with above unit. Med gry. dense. Sparse flattened vesicles near top of flow are filled w/clays ‡ silica. Dusky green ‡ blue grn clays line vesicles, or fill bottom of vesicles, and/are overlain by silica. Minor fractures (vertical?) filled w/grn clays ‡ silica. Fracture surfaces may have FeOx red brn stain or minor red brn clay. Yell brn "limonitic" stain less common. Lt grn clay less common than above clays. Predom. frac. direction 25°-30°.
	4490'-4495' VOLCANIC BRECCIA
	Med dk gry ‡ v. minor red brn. Lt/pale blue clays (may be botryoidal) ‡ green clays fill vesicles ‡ voids. Zeolites also fill vesicles/voids ‡ include clear drusy, clear foliated, ‡ white fibrous habits. Fibrous one coats or
4497'	covers others ‡ silica, when present. Silica common.
	4495'-4503.5' BASALTIC ANDESITE FLOW
	Gradational contact into vesicular, med dk gry-med gry basaltic andesite flow. Stretched/flattened vesicles filled w/blue grn ‡ gry grn clay, zeolites (a/a). No predom. fracture direction. Shear is visible along most fracture surfaces, forming hard brittle coating from above clays. Red brn FeOx stains common on fractures. Rare orange FeOx specks on fracture surf. suggesting oxidation of iron mineral.
	4503.5'-4515' VOLCANIC BRECCIA
	Dk gry, blk, red brn. More open textured than previous vol. breccia. Lt blue ‡ bluish white clays predominate as void ‡ vesicle fill.
4517'	

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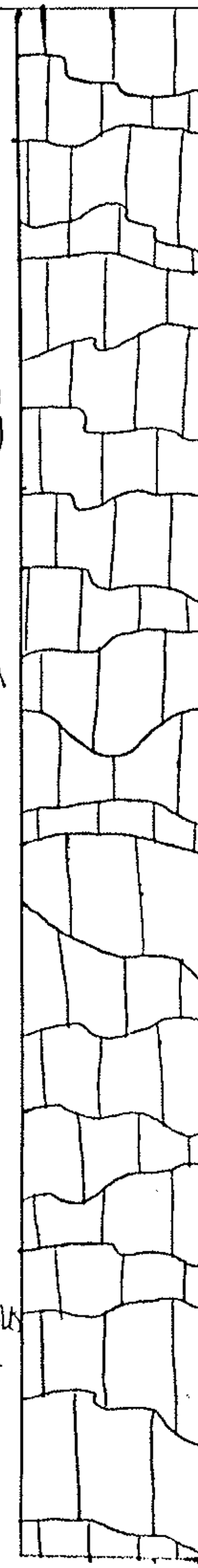

Diamond Shamrock
Thermal Power Company

CORE DESCRIPTION
40 FOOT INTERVAL

HOLE CTGH1 GEOLOGIST (S) MCDANNEL/GOODWIN
FIELD CASCADES/CLACKAMAS BASIS BINOC. MICROSCOPE DATE 8/14/86

DEPTH INTERVAL	DESCRIPTION
4437'	BASALTIC ANDESITE (A/A)
	4426'-4442' VOLCANIC BRECCIA
	4442'-4445½' BASALTIC ANDESITE LAVA med. dk gry, dense, aphyric, 8-15% 5-30mm commonly horizontally stretched vesicles with lt. to mod. 2ndary mins. Cavities & vesicles commonly lined with gry olive grn clay (less commonly gry yel. grn or dusky yel. brn), ±aclr foliated zeolite ± pale blue (±botryoidal) silica. Core breaks commonly with irregular surface @ 45°-70°. A film of dk brn ± grn gry clay is often present on break surface.
	4445½'-4449' VOLCANIC BRECCIA A/A @ 4426' with 2ndary vesicle-filling material consisting of gry grn clay ± clr drusy zeolite ± pale blue botryoidal silica
	4449'-4451½' BASALTIC ANDESITE LAVA A/A @ 4442' with rubbly top 1'. 2ndary mins in vesicles and veins are dominated by pale blue botryoidal silica & include gry grn & pale blue clays ± opalescent pale blue silica ± wht acicular radiating zeolite.
4457'	
	4451½'-4454' VOLCANIC BRECCIA A/A @ 4445½' with 2ndary mins commonly lining vesicles in the following sequence: gry grn clay ± lt. blue clay ± pale blue botryoidal silica ± wht radiating acicular zeolite (a good example is @ 4451½' in a large cavity)
	4454'-4463.5' BASALTIC ANDESITE LAVA A/A @ 4449', irreg. fracture @ 45° to 70°, 2ndary material confined to vesicles & consists of dusky grn (less com. brn) clay ± pale blue botryoidal silica (predominate material) ± wht radiating acicular zeolite (also v. common) ± (less common) soft mod. brn clay. Interval is 8-10% ≤ 10mm vesicles with common ptl. to complete 2ndary fill. Silica vns also present but less common.
	4463.5'-4477.5' VOLCANIC BRECCIA Gradational contact into volcanic breccia from above unit. Mod dk gry w/ mnr red brn near contact. Unit is generally dense. Pale grn clays, less common dusky grn clay, fibrous zeolites
4477'	

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Thermal Power Company

CORE DESCRIPTION
40 FOOT INTERVAL

HOLE CTGH-1
FIELD CASCADES/CLACKAMAS
GEOLOGIST (S) GOODWIN/McDANNEL
BASIS BINOC. MICROSCOPE DATE 2/13/86

DEPTH INTERVAL		DESCRIPTION
4317'	A L	BASALTIC ANDESITE (A/A)
		4319.5' - 4426' BASALTIC ANDESITE LAVA Med - med dk gry dense basaltic andesite. Sparsely porphyritic. Phenos ≤ 2mm of plag, pyx → clay. Light to moderate and locally heavy fracturing; variably oriented fracture. Unit is brecciated (tectonically) with short (1'-2') unbrecciated intervals (rare). Blue grn & dusky grn "clay" is predominate 2ndary mineral/alteration. Clay, silica & fibrous zeolites fill fractures & voids. Clay common on fracture surfaces.
	M L	
	M	
	L	
4417'	M H M L M L	4426-4442' VOLCANIC BRECCIA. (ABRUPT CONTACT) DK gry - med gry w/ Red brn. VESICULAR TO DENSE (MINOR SCORIA) LAPILLI & LESS COMMONLY, BLOCKS OF BASALTIC ANDESITE IN MINOR ASHY MATRIX. WELL INDURATED. VOIDS & VESICLES LINED OR FILLED BY LT BLUE TO LT BLUE GRN CLAY, BOTRYOIDAL WHT ZEOLITE, FOLIATED WHT - CLEAR ZEOLITE. DUSKY GREEN & GRY GREEN "CLAY" (BRITTLE) ON FRACTURE SURFACES; WHT ZEOLITE (FOLIATED). WITH DEPTH A FINELY ACICULAR RADIATING ZEOLITE ALSO APPEARS IN VESICLES. THE PREDOMINATE 2ndary material in INTERVAL are GRY GREEN CLAY & FOLIATED WHT-CLEAR ZEOLITE. VESICLES are rarely 10mm and commonly ≈2mm. FRACTURING is v. lt. through interval with irregular breakage @ 15°-30° & 70°-90°. 6" rubble zone occurs at base of unit.
	M L M A	
4437'		

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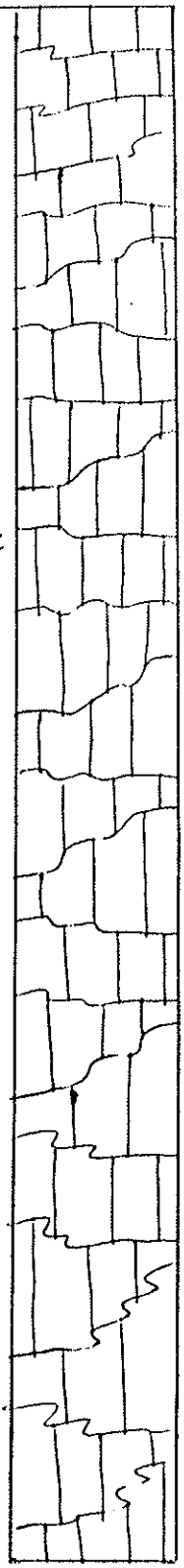
CORE DESCRIPTION

40 FOOT INTERVAL

HOLE CTGH 1
FIELD CASCADES/CLACKAMAS

GEOLOGIST (S) McDANNEL/GOODWIN
BASIS binoc. microscope DATE 8/13/86

DEPTH INTERVAL		DESCRIPTION
4357'	A L A L A M A L A L H M L M H A	BASALTIC ANDESITE (continued) (A/A) 4338'-4349' VOLCANIC BRECCIA (continued) include many possible combinations from rim to interior of the following material/minerals: dusky grn clay (less common are dusky blue grn & yellow gry clays) +/- pale blue botryoidal zeolite +/- clr drusy (+/- botryoidal) zeolite +/- wht radiating v.f. acicular fibrous zeolite --> wht clay. The fibrous zeolite is intermittently very common over 6" to 12" intervals. Less common is intermittent fracture & vesicle fill of pale blue (+/- botryoidal) silica (eg. of occurrence in vesicles within dense lava blocle from 4349' to 4353'). 4369' to 4396' is gradational to lower lava flow with common vesicular blocks with larger (≤1cm) cavities than upper unit, most of which have v. minr 2ndary mins. @4348.5' microscopic native copper flakes are present on zeolites/clays coating fracture.
4377'		4376'-4390½' BASALTIC ANDESITE LAVA med. dk gry, aphyric to v. sparsely porphyritic (<1% phenos +/- plag, +/- pyx → FeOx and/or gry grn clay), v. lt. amt 2ndary mins. in dense unit w/ lt. (generally) fracturing @ variable attitude (15°, 45°, 80°). Vesicles absent. Fracture fill/veinlets include gry grn clay rims +/- pale blue (+/- botryoidal) silica. 4376'-4384' lt. amt. tectonic brecciation (but rock remains (consolidated) unbroken) with clay-silica in v. thin veinlets with subvertical attitude. Lt. amt. FeOx (lt. olive brn & mod. red) mixed w/ clay near base of interval adjacent to fractures. 4390½'-4399½' VOLCANIC BRECCIA same as above @ 4338', med. dk gray, dense with sparse to moderate small (≤5mm) vesicles, vesicles filled v. fully to completely w/ lt. amt. +/- grayish blue grn clay +/- gry grn clay +/- wht to v. pale blue botryoidal zeolite +/- soft moderate brn clay, Unit is unfractured.
4397'		



Diamond Shamrock
Thermal Power Company

Form 2

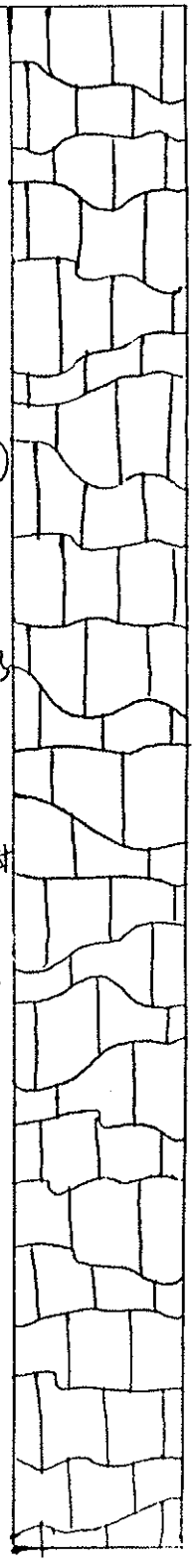
CORE DESCRIPTION

40 FOOT INTERVAL

HOLE CTGH-1 GEOLOGIST (S) GOODWIN/MCDANNEL

FIELD CASCADES/CLACKAMAS BASIS BINOC. MICROSCOPE DATE 8/12/86

DEPTH INTERVAL		DESCRIPTION
4317'	L	BASALTIC ANDESITE (A/A)
		4309'-4314' (Cont'd) BASALTIC ANDESITE LAVA Moderately fractured, Brecciated (tectonically) but breccia is consolidated. Fracture direction predominately vertical-sub-vertical; less commonly 45°. Grn clays (as described above @ 4300') are predominate 2ndary alteration/mineralization. Clay & silica & zeolites form veinlets & fill small voids. (Botryoidal & fibrous zeolites). Shear is common on fracture surfaces.
	A	
	L	4314'-4315.5' VOLCANIC BRECCIA (A/A, @ 4305') gry to red brn matrix & lapilli.
		4315'-4321½ BASALTIC ANDESITE LAVA (A/A @ 4309') (all lavas & breccias in this unit are sparsely & finely porphyritic w/ plag. & mafics which have altered to clay → commonly dusky green). Lava is very vesicular (25%) to 4318.5'. Vesicles filled w/ green clays (as described @ 4300' & previously...) & zeolites, silica, with clays deposited prior to silica &/or zeolites.
	M	
	M	
	H	
4337'		4321½'-4330' VOLCANIC BRECCIA med dk gry & minor red brn. Unit is relatively dense. Grn clays predominate as 2ndary mineral. (Still have slight effervescence w/HCl). White zeolite, most commonly fibrous. Trace of small yel brn-orng feox, often at site of magnetic sulfide. Habit is tabular to thin sliver; bronze color (On fracture surfaces. May be superficial material washed into hole).
	H	
	L	
		4330'-4338' BASALTIC ANDESITE LAVA (A/A) Secondary mineralization: grn & blue clays/zeolites/silica/trace of metallic % @ 4335'. Unit is very fractured, predominately vertical to sub-vertical; less commonly horizontal. V. minor shear on surfaces.
	A	
	L	
	A	
	V	
	L	
	A	
4357'		4338'-4379' VOLCANIC BRECCIA med. dk gry & minor red brn. Dense & few fractures. Most common frac. is irregular subvertical break with very light or no 2ndary mineralization, most commonly dusky grn clay. Small (≤ 6mm) vesicles have lt. amt. to mod. amt. 2ndary material - most commonly dusky grn clay and/or fibrous zeolite (± radiating). 2ndary material in vesicles



Diamond Shamrock
Thermal Power Company

CORE DESCRIPTION
40 FOOT INTERVAL

HOLE CTGH1
FIELD CASCADES/CLACKAMAS
GEOLOGIST (S) MCDANNEL/GOODWIN
BASIS binoc. microscope DATE 8/12/86

DEPTH INTERVAL | DESCRIPTION

4277'

BASALTIC ANDESITE (continued)

4271'-4282' BASALTIC ANDESITE LAVA
basal 2' with mnr 2ndary alt. relative to top of unit, fracs lt. @ 30°-45° w/ v.lt. grn gry clay, 2ndary material common in vesicles: a consequence in dudes lams. (horizontal) or rim → interior of 2-3 of the following: gry grn clay → mod. blue grn clay → pale blue botryoidal silica → clr foliated drusy zeolite → gry yellow soft clay → wht fibrous zeolite +/- soft brn gry clay. These materials plly (most common) or completely fill the ≤20 mm vesicles. Towards the center of unit silica mns increase. (≤8mm x 40mm).

4282'-4287' VOLCANIC BRECCIA
same as above at 4232', unfractured, v.lt. amt. 2ndary material in r.f. vesicles: gry grn clay +/- pale blue silica +/- wht fibrous zeolite

4287'-4298' BASALTIC ANDESITE LAVA
same as above at 4271', common fractures at subvertical & 80° w/ v.lt. amt. secondary mns: grn gry clay ± orange & yellow Fe ox stain (rim mixed w/ clay) ± botryoidal pale blue silica (also present in mnr vns); clay locally yel gry & waxy

4297'

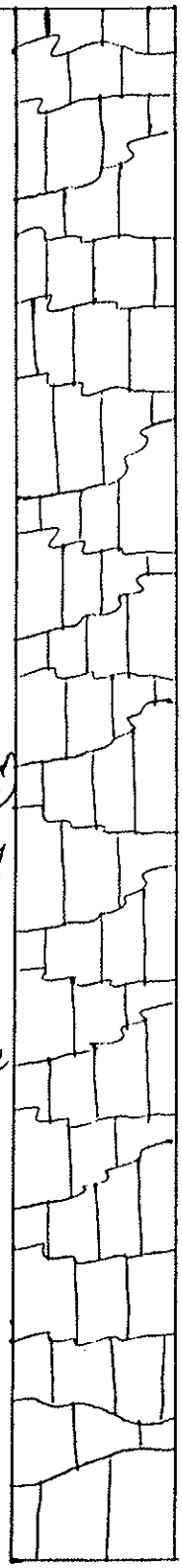
4298'-4300' VOLCANIC BRECCIA a/a @ 4282'
v.lt./NO matrix, v.lt. amt 2ndary mns in vesicular r.f.s.: (rim → interior) yel gry clay +- clr/pale blue silica +- wht fibrous (+- radiating) zeolite

4300'-4305' BASALTIC ANDESITE LAVA
a/a @ 4287', vesicular to 4302½', v.lt. 2ndary material in vesicles (≤5mm): pale blue botryoidal silica +- gry grn clay ± wht fibrous zeolite; mnr blue gry & olive gry clays also present.

4305'-4309' VOLCANIC BRECCIA
a/a @ 4298', unfrac'd, com. vesicles w/ v.lt. amt 2ndary material: rim → gry gry clay ± pale blue botryoidal zeolite ± foliated clr drusy zeolite ± wht fibrous zeolite, common 10mm cavities at base of unit w/ only film of zeolite on walls

4309'-4314' BASALTIC ANDESITE LAVA

4317'



Diamond Shamrock
Thermal Power Company

CORE DESCRIPTION
40 FOOT INTERVAL

HOLE CTGH-1
FIELD CASCADES/CLACKAMAS
GEOLOGIST (S) MCDANNEL/GOODWIN
BASIS binoc. microscope DATE 8/11/86

DEPTH INTERVAL | DESCRIPTION

4237'

BASALTIC ANDESITE (cont'd)

4232'– 4255' VOLCANIC BRECCIA

Dk gry to dk grnish gry, vesicular to dense blocks & lapilli of basaltic andesite in basaltic andesite matrix (which is v. ashy from 4232'-4236'). At 4236' breccia becomes mottled dk gry – med gry & red brn & less ashy. Dusky gry grn clay common in small voids/vesicles. Blue grn clays less common, generally. Zeolites commonly fill voids lined by clays & have drusy, fibrous (± radiating) & foliated habits; clear to white in color. Tr silica

4231'-4241' increase in vesicles w/lava (a/a @ 4217.5) common. Vesicles may be as high as 10-15% of the rock. This interval is marked by an increase in clays a/a, zeolites, & silica. Also dk yellowish grn clay common as vesicle coating in this interval. Rare pyrite.

4251'– 4255' increase in red brn ashy matrix

4257'

4255'-4267' BASALTIC ANDESITE LAVA

dense, med. gry to med. dk gry, v. sparsely porphyritic, 1% phenos plag & pyx → gry grn clay (≤1mm); lt. amt. matrix alt → gry grn clay & FeOx (red brn) mixed w/clay; lt. to mod. fracturing most commonly @ 20°-55°, common micro frac/unbroken fracs. @ subvertical with clay seams/coatings (<1mm thick); fracs commonly coated w/ v.f. amt. gry grn clay (± lt. navy shear) ± gry yellow soft clay ± yel. & red limonite stain ± wht powdery or botryoidal zeolite (latest 2ndary min. deposited); v. few vesicles

4267'– 4271' VOLCANIC BRECCIA

same A/A @ 4232'

4271'-4282' BASALTIC ANDESITE LAVA

4277' med gry, sparsely porphyritic; vesicular to 4274', dense to 4280', vesicular

Diamond Shamrock
Thermal Power Company

CORE DESCRIPTION
40 FOOT INTERVAL

HOLE CTGH-1
FIELD CASCADES/CLACKAMAS
GEOLOGIST (S) GOODWIN/MCDANNEL
BASIS binoc. microscope DATE 8/10/86

DEPTH INTERVAL	DESCRIPTION
4197'	BASALTIC ANDESITE (A/A) 4193'-4201'- silica fills increased void space
	4210'- 4217.5' (BASALTIC ANDESITE) VOLCANIC BRECCIA (a/a @4148') Voids are generally only coated/filled w/clays, mnr zeolite, silica is present only in trace amounts. This is in contrast to above lava unit.
4217'	4217.5'-4232' BASALTIC ANDESITE (LAVA FLOW) Med gray - med dk gry - med bluish gry. Sparsely porphyritic w/ phenos of plag, mafic phenos ox.→ red clay. Unit is brecciated (tectonic/secondary brecciation) between 4217.5'- 4224', but consolidated, Unit is lightly to mod. fractured w/ most common direction 30°, less commonly vertical. Mnr shear on fracture surfaces. Grayish blue grn to dusky blue grn "clay" is pervasive throughout rock, most noticeably on fracture surfaces & between breccia fragments. Wht clay is common & typically overlies grn clays. Secondary FeOx (± hydrous FeOx?) yel brn & red brn common on fracture surfaces & as linear stains throughout core, typically following hairline fractures. No silica found in this unit.
4237'	

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Diamond Shamrock
Thermal Power Company

CORE DESCRIPTION
40 FOOT INTERVAL

HOLE CTGH 1
FIELD CASCADES / CLACKAMAS

GEOLOGIST (S) McDANNEL/GOODWIN
BASIS binocular microscope DATE 8/4/86

DEPTH INTERVAL		DESCRIPTION
4157'	LALMLA	BASALTIC ANDESITE (A/A) 4143'-4175' continued Volcanic Breccia: common red-brn & lt. brn as well as grayish matrix, unfrac'd exc. irreg. break @ 0°+90°, soft brn gry clay common in larger vesicles & break-zones, Sndary material in cavities & sm. (<2mm) vesicles is v. lt. amt. Many cavities have only v. thin coatings. The most common vesicle fill → interior sequence is: gry grn clay → ± clr drusy zeolite → ± wht fibrous zeolite ± soft brn clay. Also present are pale grn yel, olive grn, & blue grn clays as vesicle fill in mnr amts. Mnr amt gry grn botryoidal drusy zeolite is also present in larger vesicles.
4177'	L	4175'-4210' BASALTIC ANDESITE LAVA Breccia (above) passes into vesicular top (~4') of basaltic andesite lava. Vesicles filled w/ blue grn clay, dk gry grn clay (which underlies blue grn clay in some vesicles), silica, &/or zeolites. Dk gry grn to dusky blue grn clay most common & is pervasive throughout rock. Silica is wht to lt. blue & may replace blue grn clays. Zeolites include v. fine drusy crystal coating, acicular & radiating fibrous habits. (Medium hard botryoidal coating may also be silica). Zeolite may coat silica (which coats clays) in some vesicles. Fracture is generally light & 55° or 75°-80° ∠. 4183'-4187' rock is brecciated (tectonically) slightly, w/ dusky blue grn clays & less commonly, silica filling fractures, 4185'-4188' ~50° fracture angle common, 30° less common. slight shearing on fracture surfaces 4188'-4190.5' increase in vesicularity = increase in clays & silica
4197'		

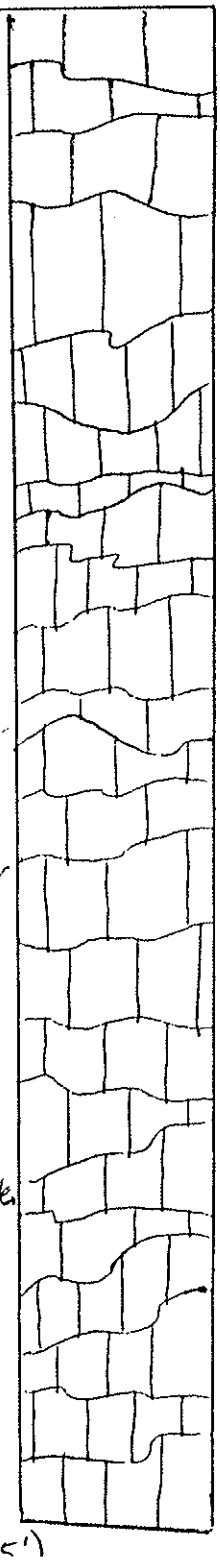
CORE DESCRIPTION

40 FOOT INTERVAL

HOLE CTGH-1
FIELD CASCADES/CLACKAMAS

GEOLOGIST (S) GOODWIN/McDANNEL
BASIS BINOC. MICRO. DATE AUG. 3, '86

DEPTH INTERVAL	DESCRIPTION
4117'	BASALTIC ANDESITE (A/A) 4105'- 4122' VOLCANIC BRECCIA (cont'd) 4122'- 4125.5' - BASALTIC ANDESITE LAVA [A/A @ 4072'] Clays & silica form small veins following fracture. Fracture predominately vertical & subvertical, but includes near horizontal & 45° orientations. Clays are predom. blue grn. White clay less common. Clays & silica also fill voids (vesicles). Some clay appears to have been silicified/replaced by silica. 4125.5'-4139' VOLCANIC BRECCIA [A/A @ 4105'] red gray to dk gray, ± vesicular (<10mm w/ common 2mm voids) rfs. in basaltic andesite matrix of grayish shade ± red brn matrix a/a, irreg-break ⊥ to ∠ w/ v. few fracs, v. lt. amt 2ndary mins w/ many empty vesicles, vesicles commonly (larger ~2mm) rimmed by gry grn clay then either clr/lt. gry drusy zeolites &/or wht acicular radiating fibers in spheroidal clusters (natrolite) = a zeolite, smaller vesicles commonly filled w/ clay of one color or horizontally laminated sequence of clays eg: mod brn - blk - blue grn - lt blue (chert) & clr/wht drusy zeolite &/- soft brn gry clay. Clays are locally silicified though no silica was observed. Rare microscopic copper flakes on zeolites or clays in larger open vesicles. The rare fracs have gry grn clay & wht fibrous zeolite.
4137'	4139'-4143' BASALTIC ANDESITE LAVA [A/A @ 4122'] relatively unfracd w/ irreg ⊥ break, rare fracs w/ coatings gry grn clay ± clr/lt gry drusy zeo. ± wht fibrous zeo., vesicles coated w/ same materials as fracs + lt blue clay & soft brn gry clay, sparse silica vns (+vesicle fillings also) are present (<5mm x <30mm, pale blue)
4157'	4143'- 4175' Return to VOLCANIC BRECCIA [A/A @ 4105']



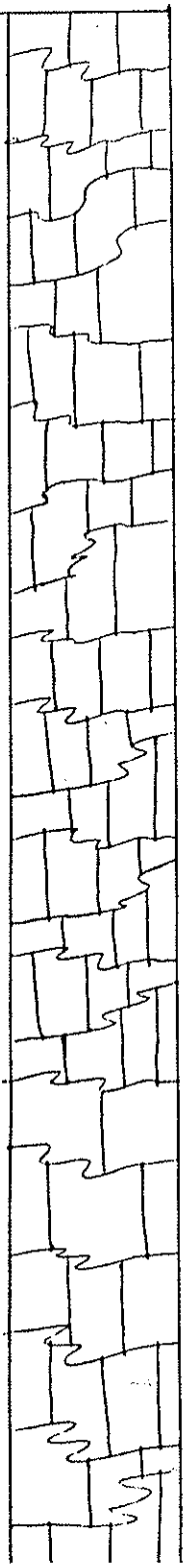
Diamond Shamrock
Thermal Power Company

CORE DESCRIPTION
40 FOOT INTERVAL

HOLE CTGH 1
FIELD CASCADES/CLACKAMAS

GEOLOGIST (S) McDANNEL/GOODWIN
BASIS binoc. microscope DATE 8/2/86

DEPTH INTERVAL		DESCRIPTION
4077'	LAVA FLOW	BASALTIC ANDESITE (A/A) 4072'-4081' (cont.) BASALTIC ANDESITE LAVA silicified gry grn and rarer lt. blue clays. Vesicles @ top of interval also contain a finely acicular wht fibrous zeolite (natrolite?). A notable increase in VN/fracture coating silica & decrease in clay occurs in this interval. 4081'-4089' Return to Volcanic Breccia a/a @ 4068', very lt. or no fracture, lt. amt. 2ndary mins in vesicles, gry grn clay in small (< 1mm) more common vesicles & clr fibrous zeolite in larger (2-5mm) relatively sparse vesicles on ± gry grn clay (thin coating) 4089'- 4105' BASALTIC ANDESITE LAVA (a/a @ 4072') Rock is fractured but generally unconsolidated, with broken/fractured intervals. Fractures are commonly filled w/ grn blue "clay" & gry grn "clay" or silica, & are oriented in vertical to sub-vertical direction (i.e. high angle to core length). Clays & silica are also in small voids & silica appears to replace some clay. Fracture surfaces have thin coating of above grn clays, plus a translucent whitish coating that is relatively soft, thin & brittle. HCl causes weak effervescence of green/blue grn "clays." Darker grn clays were deposited first, followed by blue green, then silica or translucent whitish material described above. Mnr. shear on fracture surfaces. (wht clay also present on frac. surf.)
4097'		
4117'		4105'- 4122' BASALTIC ANDESITE VOLCANIC BRECCIA (A/A @ 4081') Rare fractures: 0°-20°, & ~75°. Vesicles & small voids filled predominately w/ white zeolites & wht clay. Lesser blue grn, gry brn clays. Gry Grn also v. common. Veins filling fractures are commonly gry green clay (thin coating) along walls, w/ a drusy lining of very fine zeolites, & filled w/ white clay (from zeolites). Wht clay dissolves in dilute HCl.



Diamond Shamrock
Thermal Power Company

CORE DESCRIPTION
40 FOOT INTERVAL

HOLE: CTGH-1
FIELD: CASCADES / CLACKAMAS

GEOLOGIST (S): GOODWIN / MCDANNEL
BASIS: BINOC. MICRO. DATE: AUG 2, '86

DEPTH INTERVAL	DESCRIPTION
4037'	

H A ↓ L ↓ A L M L ↓ M H ↓ M L ↓ H M ↓ L ↓ A L ↓ A L ↓

BASALTIC ANDESITE (A/A)

Cont'd VOLCANIC BRECCIA from 4029' to 4044.5
voids, vesicles filled w/ grn clays, zeolites, wht clay & brn gry clay. Voids are often thinly lined w/ med grn clay & then coated w/ very fine zeolite(s). Dk gry grn "waxy" clay in matrix. Less blue grn clay in this interval than previous ones.

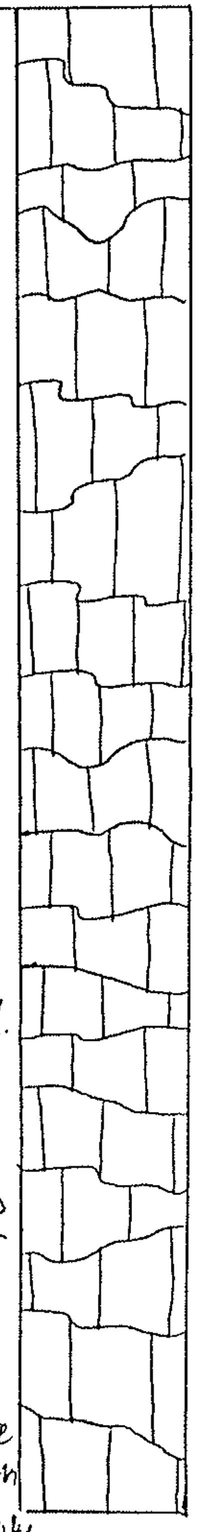
4044.5 - 4068' BASALTIC ANDESITE LAVA
dk gry, v. sparsely porphyritic with 1% plag & (pyx → clay), dense, finegrained & brittle, moderate & locally heavy fracturing, most commonly at 45° & vertical with lt. to v. lt. amt 2ndary mins. deposited as thin, surface films & less commonly seams. From rim to interior of fracture, a common sequence is grygrnclay (most common) → lt. blue clay (rarer) → wht acicular radiating fiber clusters (a zeolite = Natrolite?). From 4058'-4062.5' grn gry clays decrease & a thin coat of wht clay ± pale blueclay is predominate. At 4058' a waxy brnclay appears & continues to base of interval. Vesicles are uncommon & v. small (<1mm) with grygrnclay fillings. Clr silica vns are rare & also intermittent yel. & orange FeOx/limonite is rare adjacent to fracs. Mnrclay shear is intermittent, Moderate Red iron clay is sparse & begins @ 4063' as vesicle fill & frac. coating material. @ unit base a film of pale blue botryoidal silica on grygrnclay is present as fracture filling material.

4057'

4068' - 4072' Return to Volcanic Breccia, dense & unfractured, vesicles (<2mm) ptlly filled w/ thin lam grygrn clay covered w/ drusy clr zeolite ± wht fibrous (Natrolite?) zeolite

4072' - 4081' BASALTIC ANDESITE LAVA
same as @ 4044.5' w/ less fractures & vesicular top 3', 4072'-4073' has common vert.-subvert. fracs w/ silica vns, lower fracs are @ 45° & vertical, silica ≥ = or > grygrnclay in common vns (<4mm X 90mm), (≤ 2mm X 5mm) vesicles filled w/ v. pale blue silica ± commonly

4077'

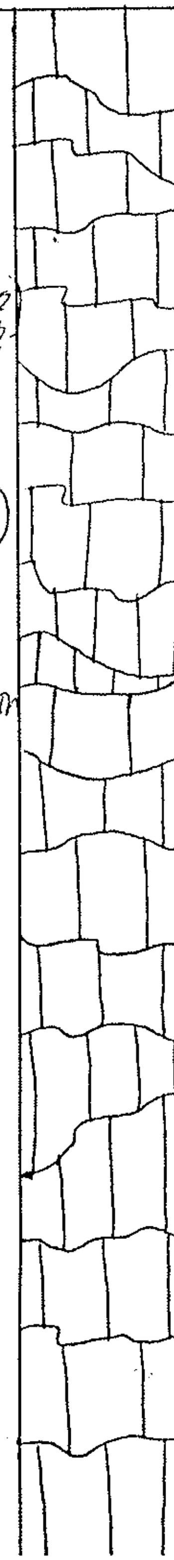


Diamond Shamrock
Thermal Power Company

CORE DESCRIPTION
40 FOOT INTERVAL

HOLE: CTGH 1
FIELD: CASCADES / CLACKAMAS
GEOLOGIST (S): McDANNEL/GOODWIN
BASIS: binoc. microscope
DATE: August 2, 1986

DEPTH INTERVAL	DESCRIPTION
3997'	A L ↓ A — BASALTIC ANDESITE (A/A)
	3999.5'-4010' Return to basaltic andesite breccia, matrix appears finer & denser than most preceeding breccias of this kind. Small voids (≤1mm) are filled w/ clays (greens, a/a wht, gry) & zeolites. Clay is common but not abundant. Wht clay & zeolites precipitated after the dk green & blue grn clays. Foliated clear mineral also in voids (zeolite? gypsum?) (Fibrous & acicular zeolites, less commonly fine, rectangular? form)
	L ↓ L ↓ M — 4010'- 4029' BASALTIC ANDESITE LAVA (a/a @ 3984) Generally v. fractured—subvertical, ~40° & 75°-80°. Fracture surfaces show shear. Thin green & blue green "clays" on surface are harder & more brittle than most clays but have no form (i.e. amorphous) are accompanied by thin brittle, clear coating of unidentified material. When scratched the coatings (green & clear) effervesce slightly w/HCl. Silica fills in voids & forms veins in fractures. Veins/voids may be lined w/ blue grn or dk grn "clay," which may have become silicified. (Veins are most often vertical → sub-vertical in orientation). Other veins show green "clays" layered w/ silica in fractures.
4017'	↓ H ↓ M ↓ L ↓ M
	4029'-4044.5 volcanic breccia a/a @ 3999.5'. Same features & secondary mineralogy a/a. (see following page, also).
	↓ L A ↓ L A
4037'	



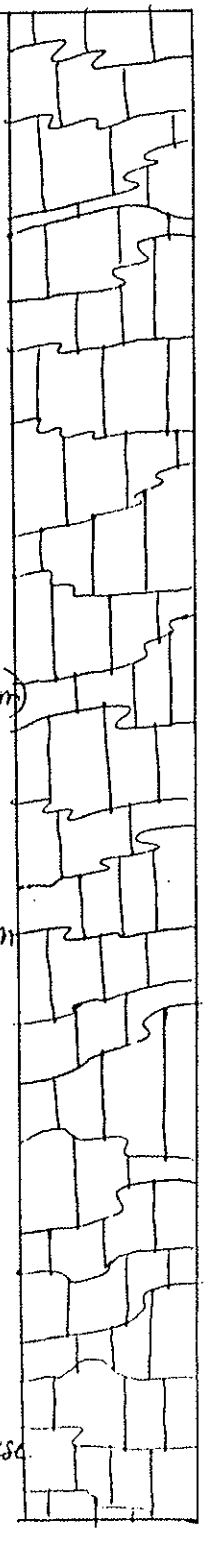
CORE DESCRIPTION

40 FOOT INTERVAL

HOLE CTGH-1 GEOLOGIST (S) McDANNEL/GOODWIN

FIELD CLACKAMAS/CASCADES BASIS BINOC. + CORE DATE AUG. 1, 1986

DEPTH INTERVAL		DESCRIPTION
3957'	LILLA	BASALTIC ANDESITE cont'd VOLCANIC BRECCIA, A/A. 3958'-3959' subtle change in matrix character: med. ash size rock fragments are equigranular with a v. minor fraction of smaller material. Color is gry grn due to common alteration of v. f.s → clay of same color. 3959'-3961' dense b-a. lava, light amt. vesicle filling clays a/a @ 3922½', clr silica also fills vesicles 3961'-3965' Return to Volcanic Breccia with matrix character as @ 3958' 3965'-3982' Dense b.a. lava, commonly fracd @ 50°-70° with very lt. amt grn gry & lt. blue clays ± pale blue (botryoidal) silica on clays (below 3972' rock is finely fracd by tectonic brecciation @ 45° to subvert. most commonly, thin vns (<3mm) & vnlets are common through 3982'). lt. amt. vesicle filling med blue grn, olive grn & gry grn clays above 3972' (base of zone of horizontally flattened (<8mm) vesicles which also contain lt. amt. pale blue/wht silica & or a white zeolite which is occasionally acicular & v. finely fibrous (natrolite?) - on rim clays)
3977'	LMILA	3982'-3984' Return to Volcanic Breccia, no fracs, lt. blue & gry grn clays in vesicles & cavities (± wht zeolite) 3984'-3999.5' Dense basaltic andesite lava, vesicular to 3989½' with gry grn, pale blue (opal?) & clr silica & white zeolite (natrolite?) in cavities & vesicles, local v. lt. FeOx staining adjacent to fractures, minr clays a/a (in vesicles) on fracs plus v. lt. amt soft brn gry clay, fracs. commonly @ 60° & 20°. From 3991'-3999.5': fine (tectonic) fracturing w/ vn & vnlets silica & gry grn clay. From 3997.5'-3999.5': increase in zeolites with increase in vesicles & aligned @ 45° (stretched) at unit base
3997'	LLHM	



Diamond Shamrock
Thermal Power Company

CORE DESCRIPTION
40 FOOT INTERVAL

HOLE: CTGH 1
FIELD: CASCADES/CLACKAMAS
GEOLOGIST (S): McDANNEL/GOODWIN
BASIS: binocular microscope DATE: August 1, 1986

DEPTH INTERVAL	DESCRIPTION
3917'	BASALTIC ANDESITE (A/A)
	3915'-3922½' Return to basaltic andesite lava, most common fracs @ 30° & 90° in mod. frac. interval, rock commonly frac'd but unbroken w/ thin vnlets wht & grngry clay & clr. zeolites. Lt. brn clay also present but less common in vnlets & fracs., local lt. clay pt'l. silicification.
	3922½'-3959' Volcanic breccia (a/a @ 3902). Fracturing decreases from above lava. Light amt of clays fill voids & mnr veinlets. Blue grn, gry grn clay commonly overlain by pale blue clay & may be coated by drusy zeolite (v. fine). Blue clay in voids is often botryoidal. Soft, gry brn clay common in voids. Minor white clay. V. fine acicular to fibrous zeolite(s) (natrolite?) also in vugs/voids ± clay. Small amt. of foliated, clear mineral cleaves into v. thin sheets (@ 3924.5'). No silica. Thin med brn coating of Feox(?) common on many fracture surfaces & predates clays. Mnr orng oxidation (local).
3937'	
3957'	

L ↓ M ↓ I A ↓ L A L ↓ A ↓ L A L L A L ↓ I L ↓ A

Diamond Shamrock
Thermal Power Company

CORE DESCRIPTION
40 FOOT INTERVAL

HOLE: CTGH-1
FIELD: CASCADES / CLACKAMAS

GEOLOGIST (S): MCDANNEL / GOODWIN
BASIS: BINOC. MICROSCOPE DATE: JULY 31, 1986

DEPTH INTERVAL	DESCRIPTION
3877'	

A L ↓ A ↓ L ↓ M ↓ I ↓ A ↓ L A I M ↓ L H M A ↓ H A ↓ L M ↓

BASALTIC ANDESITE (A/A)

3860'-3873' Return to Basaltic andesite lava [a/a @ 3852']. Increased fracturing, typically at high angle 0°-15°, less commonly ~45° & 80°. Mnr shear on fracture surfaces. Abundant blue grn (waxy) clay + white clay on frac. surfaces, mnr pale blue. V. common red brn-orange red & dusky yellow oxidation -- usually follow small cracks/fractures.

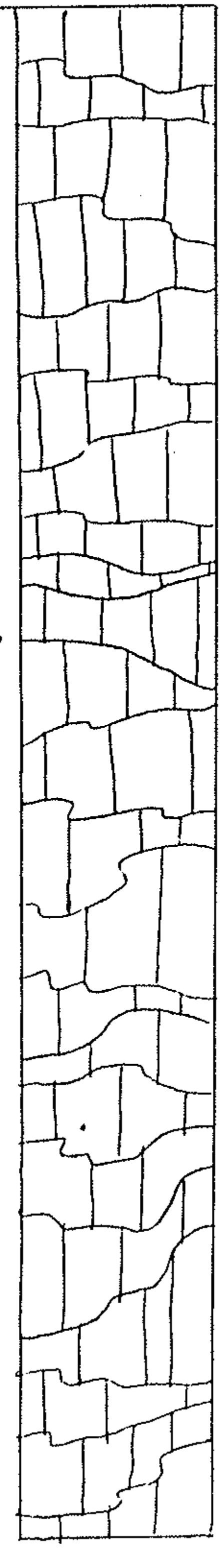
3873'-3896' Volcanic breccia, a/a @ 3839'. secondary minerals/clays a/a w/ gry grn & mod blue most common, sequence from rim to interior on vesicles is typically grygrn → mod blue → lt. blue → soft gry brn clay, a lt. amount of clr drusy zeolite commonly occurs on clay in cavities; rubbley @ 3889'-3891' & 6" interval at base of unit, v. minor fracturing, core breaks irregularly @ 90°

3897'

3896'-3902' Return to basaltic andesite lava [a/a 3852'] fracturing increases w/ common fracs @ subvert & 30°, clays on fracs are lt. w/ waxy wht & gry grn colors predom. over mod blue & pale blue & pale blue grn, rare limonite? yellow & orange oxides as @ 3873'

3902'-3915' Volcanic breccia, a/a @ 3839'
from 3903' to 3907' a notable increase in the variety of clays & zeolites occurs, a common sequence rimming vesicles towards the interior are blk, gry grn, mod blue, gryish olive grn & wht clays followed by a clear zeolite w/ rare matted or acicular v. fine wht zeolites last deposited. All clays are <<1mm laminations.
pale blue silica vns (<6.5mm) & vesicle fill occurs intermittently w/ overall lt. amt., microscopic round plates of copper also occur on fracs. (rare concentration)

3917'



Diamond Shamrock
Thermal Power Company

CORE DESCRIPTION
40 FOOT INTERVAL

HOLE CTGH-1
FIELD CASCADES/CLACKAMAS
GEOLOGIST (S) GOODWIN/McDANNEL
BASIS BINOC. MICROSCOPE DATE JULY 31, 1986

DEPTH INTERVAL	DESCRIPTION
3837'	BASALTIC ANDESITE (A/A)

3835'-3839' Basaltic andesite lava. Top 1.5' vesicular w/silica the predominate vesicle fill. Silica is white to blue & typically fills upper part of vesicle & is underlain by lt blue grn clay which typically has been silicified. In other vesicles blue grn clay overlies grn gry clay. Less common, soft, brn gry clay may fill vesicle or be at center of vesicle lined by other clays. V. light coating of blue grn & gry grn clays on frac. surfaces. V. minor fractured ~15°, 180°. 3838' is (tectonically) brecciated but consolidated.

a/a @ 3813', 3826.5'

3839'-3852' Volcanic breccia a/a @ 3829'
blue grn, pale grn, gry grn, white fill vesicles & voids. Mnr. brn gry (soft) clay also. Clays form minor veinlets. Vesicles are often layered from bottom to top: dk grn → blue grn → lt blue/white. (No silica found). Fr zeolite. 3848'-3850' - Rock is fractured & broken = mod. rubbly. Sheared surfaces. Fracture direction most commonly ~25°-30°.

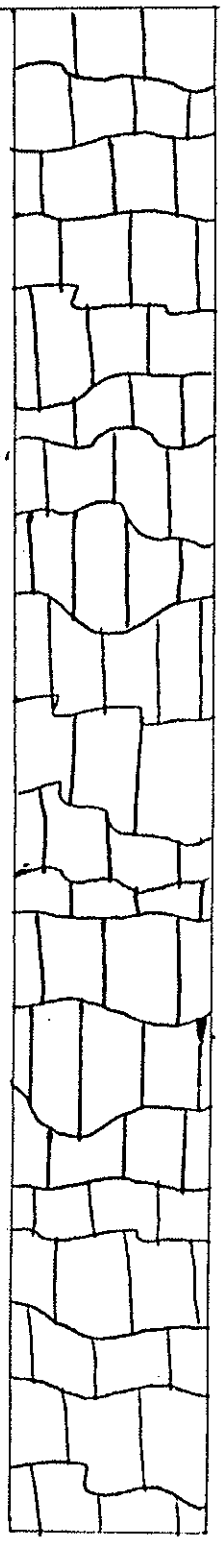
3857'

3851' silica fills vugs

3852'-3860' Basaltic andesite lava a/a @ 3835'
Brecciated (2ndary - i.e. tectonic) but Consolidated. Little to no movement occured between breccia fragments. Gry grn & dk blue grn clay fill narrow spaces between breccia fragments. Brecciation decreases by 3857' Broken frac. surfaces show minor shearing. Clays appear more abundant in this interval over the above vol. breccia interval. Grn clays (as described numerous times above), white clays, & minor silica occur as veins & void fill. Clays v. common on fracture surfaces. Red brn - orange red & dusky yellow Fe oxide stains(?) are common in this interval.

3860'-3867' Volcanic breccia, a/a @ 3839'. Clays as described above + zeolite.

3877'



CORE DESCRIPTION

40 FOOT INTERVAL

HOLE CTGH-1 GEOLOGIST (S) GOODWIN/McDANNEL

FIELD CASCADES/CLACKAMAS BASIS BINOCULAR SCOPE DATE JULY 30, '86

DEPTH INTERVAL	DESCRIPTION
3797'	BASALTIC ANDESITE (A/A)
	3796'-3803' (cont.) mod. to intense fracturing w/ fracs @ subvertical, 30°, & 70°; light amt. secondary mins on fracs: discontinuous film admixed blue & grygrn clay ± clear drusy/film zeolite on top of clays or by itself; sparse vesicle filling by clays of same color + minr. wht clay on interior of vesicles lined w/ grygrn clay; sparse ltgry silica & local clay silicification
	3803'-3813½' return to volcanic breccia as @ 3745', finely scoriaceous lapilli sz rf.s to 3806, locally matrix clay alteration increases (grygrn clay & coloration of rock), intermittent very fine white acicular zeolite in voids on clr zeolite, radiating needles suggests natrolite eg 3807½' & 3814½', minr soft brn clay in larger (>10mm) vesicles
	3813½'-3819' return to dense med. gray finely & sparsely porphyritic basaltic andesite lava, mod. frac. @ 45° & 70° w/ frac. alt. a/a @ 3803', minr local silica vnl (2x25mm max.), zeolites including natrolite as @ 3803'
3817'	
	3819'-3826½' return to volcanic breccia as @ 3745' common open voids w/ light amt. secondary clays & zeolite: vesicles >2mm generally have a rim of grn gry clay & an interior of clr drusy zeolite (no natrolite), smaller vesicles are empty or filled w/ grygrn clay, silica, &/or soft brn clay
	3826½'-3829' return to dense basaltic andesite lava, vesicles filled w/ wht, grygrn clays, &/or silica. Clays locally/adjacent to vns silicified, minr natrolite? as @ 3803'
	3829'-3835' return to volcanic breccia, very lt. amt. secondary mins. as @ 3819'
3837'	

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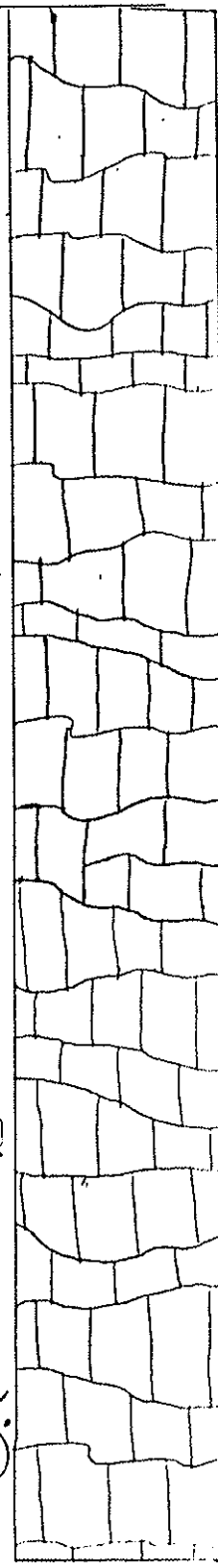
Diamond Shamrock
Thermal Power Company

CORE DESCRIPTION
40 FOOT INTERVAL

HOLE CTGH-1 GEOLOGIST (S) GOODWIN/MCDANNEL
FIELD CASCADES/CLACKAMAS BASIS BINOC. SCOPE DATE JULY 30, 1986

DEPTH INTERVAL	DESCRIPTION
3757'	BASALTIC ANDESITE (A/A)
	3758.5 ~35° fracture w/minor shear on frac. surface
	3761'-3763' denser interval = basaltic andesite lava. Fewer voids ∴ there is less clay than in breccia interval(s). Minor silica as void filling & forming thin (~2mm) vertical veinlet in green clay-lined fracture (3763').
	3763'-3796' return to volcanic breccia per above description @ 3745'; white clays in vesicles & voids. Green clays less common
	3769' - 30-40° fracture (1) w/ 0.5 cm gry clay on frac. surface
	3772'-3773' - broken, less consolidated (slightly) interval.
3777'	
	3782'-3783' - rubble zone
	3783'-3787.5' - many of vesicles & voids are not lined or filled w/clay
	3789'-3790' - rubble zone — predom. vertical-sub-vertical fracturing
	3792'-3796' - matrix of breccia is red brn due to primary oxidation.
	3796'-3803' rock is denser, not oxidized a/a @ 3792'. Basaltic andesite lava a/a @ 3761' (& numerous preceding flows) near vertical fracture @ 3796.5' is coated w/green & white moderately hard, brittle (thin) deposit → siliceous?
3797'	



CORE DESCRIPTION

40 FOOT INTERVAL

HOLE CTGH1
FIELD CASCADES / CLACKAMAS

GEOLOGIST (S) McDANNEL / GOODWIN
BASIS Binoc Scope DATE JULY 29, 1986

DEPTH INTERVAL	DESCRIPTION
3717'	BASALTIC ANDESITE (A/A) lt. blue clay is predominate in small (≤2mm) vesicles, silica and silicification of clays is sporadic (10' between occurrences) and diminishes with depth. Silica occurs in (≤10mm) larger vesicles only and no veins. Otherwise rock is as described @ 3677'. Soft brn clay occurs fairly commonly in ≈2mm vesicles and in seams where the rock has broken irregularly, often @ 90° to ∫. 3715'-3721' slight increase in size & # of vesicles. wht, lt. blue grngry clays & clr drusy zeolite in vesicles, as @ 3677'. Clays are commonly laminated in larger vesicles w/ the zeolite occurring at the top of the void on occasion (last in the sequence). 3721'-3723½' ruddy, many fractures barren or v. lt. amt. lt. gry/clr zeolite & grygrn clay, silica rare/absent below 3720' 3723'-3727½' med gray dense, vesicular b.a. lava, fracs. @ subvert ∫ 45°, lt. amt clays & lt. gry zeolite on fracs & in vesicles
3731'	3727½'-3743' Volcanic breccia continues as @ 3677', overall v. light amt grn gry clay & clr. drusy zeolite in vesicles & fractures, lt. blue clay becomes rare & overall alteration is decreasing. 3743'-3745½' dense b.a. lava w/ mod. amt. wht clay in ≤5mm vesicles. Lesser amt. waxy lt. blue & grygrn clays & clr. zeolite
	3745½'-3761' Volcanic breccia, a/a @ 3727½. microscopic copper (@ 3757) in vugs w/ botryoidal - mammillary lt blue to milky opaline (?) material that forms v. small stalagtites. Clay coating on broken surfaces is very light.
3757'	

LITHOLOGY: A

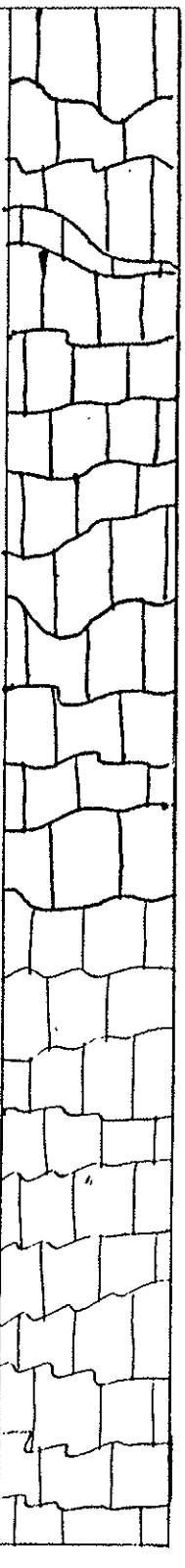
Diamond Shamrock
Thermal Power Company

CORE DESCRIPTION
40 FOOT INTERVAL

HOLE CTGH-1
FIELD CASCADES/CLACKAMAS

GEOLOGIST (S) GOODWIN/McDANNEL
BASIS BINOC. SCOPE DATE JULY 28, 1986

DEPTH INTERVAL	DESCRIPTION
3677'	BASALTIC ANDESITE (A/A) Volcanic breccia continues. Rock is well indurated & generally dense with smaller & fewer intergran voids than observed @ 3600'. Small (≤2cm) pervasive vesicles & vugs filled w/waxy "clays" of variable hardness & include gry grn, gry blue grn (to turquoise), pale blue. Soft brn gry to gry brn clays common. Clays typically fill vugs from rim to interior in this order: gry grn → pale blue, and may have drusy coating of fine clear zeolite or silica. Cross section of this sequence is microscopically banded w/ fine crenulations. Soft brn gry-gry brn clay is the most recent. Botryoidal form in clay is common. Clay & silica occur also, as short veinlets. Silica commonly fills vugs/vesicles. Rock has a tendency to break horizontally.
3697'	3690'- increase in fracturing?/breaking, forming discs (horizontal break) of variable thickness. 3687'- slight increase in gry brn clay, coating break/fracture surfaces @ 3693.6'-3695' forming clay seams ≤ 1cm. 3699' several ≤10mm vesicles w/from rim to interior: pale gry grn clay, lt. blue gry botryoidal clay/zeolite?, clustered wht radiating 1mm fibers (open into void interior) = zeolite 3701' clr zeolite microstalactites drip from top of ≤15mm vesicles w/ lt. blue gry botryoidal & drusy zeolite coating & pool @ bottom 3703' 30mm cavity w/ sparse ≤1mm copper flakes on top of clr drusy zeolite 3704' heavy soft gry brn clay in narrow rubbly zone (3") 3714' >60mm cavity lined w/ gry-grn clay, clr drusy zeolite, ± soft gry brn clay + rare v.f. dissem. microscopic copper flakes
3717'	



Diamond Shamrock
Thermal Power Company

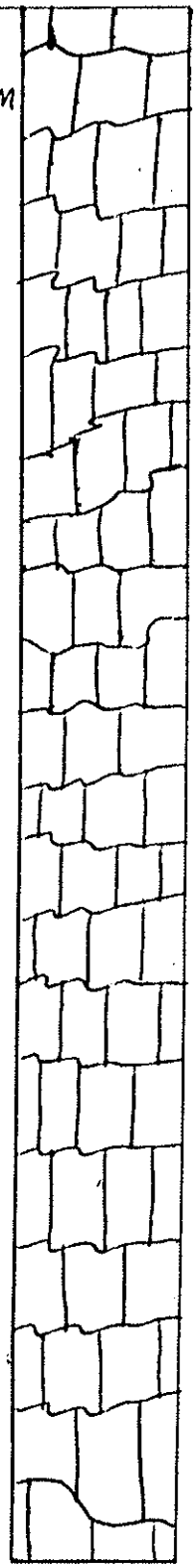
CORE DESCRIPTION

40 FOOT INTERVAL

HOLE CTGH 1
FIELD CASCADES/CLACKAMAS

GEOLOGIST (S) MCDANNEL/GOODWIN
BASIS BINOC. SCOPE DATE JULY 28, 1986

DEPTH INTERVAL	DESCRIPTION
3637'	BASALTIC ANDESITE (A/A) 3639' Wht botryoidal zeolite coats grn gry clay in 5-10mm vesicles. Soft ltgray brn clay partially fills void interior. 3646' grn gry clay less common over 1'-2' interval, lt. blue clay is predominate with vnlets, vesicles filling, & sm. frac. coating occurrence. Occasionally lt. blue clay is coated w/ very thin film of clr zeolite? / wht clay.
3651'	
3677'	



CORE DESCRIPTION

40 FOOT INTERVAL

HOLE CLACKAMAS/CASCADES
FIELD CTGH-1

GEOLOGIST (S) McDANNEL/GOODWIN
BASIS BINOC. SCOPE DATE JULY 27, 1986

DEPTH INTERVAL

DESCRIPTION

3597'

BASALTIC ANDESITE (A/A)

3600.5'-3609.5' breccia grades into Basaltic andesite lava [Lava is v. similar to those lavas described between volcanic breccias since 2965.6': med to med dk gry, finely & sparsely porphyritic, w/phenos of plag, pyx, ol?] fracture increases over that of previous interval. Prominent direction is vertical/sub-vertical, w/ less common 45°-75° fractures. Pale blue, gry grn, gry blue grn clays thinly coat fracture surfaces, form thin veinlets, fill vesicles & voids. Gry brn & wht clays are less common & are found in vesicles & voids. Gry brn is the last clay to fill voids & is softer than the others. SiO_2 also fills vesicles, voids, & forms veinlets — color ranges from wht to the blues of the above described clays, & may replace some of the clays. Fine, clear zeolites may coat clays in voids. Clay may be botryoidal

3609.5'-3725' Volcanic breccia (a/a @ 3546'). Intergrain voids are small (generally ≤ 2mm) & are filled w/gry blue grn & gry grn clays, typically botryoidal. Clays may be silicified; white & blue silica common. Wht clay coats blue grn when both are present. Tr clear zeolite typically as drusy coatings on clays, rare on fracture surfaces. 3 cm void filled w/: grn clay at bottom, overlain by lt. blue, & topped w/silica (white - v. pale blue). Short interval (3613'-3615') of dense basaltic andesite lava (a/a @ 3606') is more fractured than breccia & has more vesicles/voids & has more 2ndary silica than does breccia. Rare, fine plate of copper. Fracturing is minor, most commonly @ 30°-45°. Irregular break ⊥ to ∠ is more common and occasionally has soft lt gry clay seams. Silica occurs intermittently - usually in intermed. sz vesicles (1-8mm) in a 6" to 18" thick band (assoc. w/clays or lay itself). Intermittent = every 2' to 10' for silica occurrence.

3630' 2cm thick brn gry clay seam (soft) & 2mm coating on opposite fracture wall of clr zeolite and wht clay; surface of zeolite disturbed/resorbed

3636½'-3638½' matrix color becomes gry grn as clays of same color increase in voids of r.f.s & vesicles, clr zeolite remains common drusy coating on clay; Light silica in 3-10mm vesi-

3617'

3637'

CORE DESCRIPTION

40 FOOT INTERVAL

HOLE CTGH 1
FIELD CASCADES / CLACKAMAS

GEOLOGIST (S) McDANNEL / GOODWIN
BASIS BIN. MICROSCOPE DATE JULY 27, 1986

DEPTH INTERVAL	DESCRIPTION
3557'	**BASALTIC ANDESITE (A/A)**

3546'-3559' Return to Volcanic Breccia w/ 3532' character except red-brn matrix is less abundant. (Above 3549') Interval is matrix-supported w/ common gry grn colovation (due to ≤3" thick layers of fine ash-s2 rfs (altering) --> grn gry clay more commonly). light amt clr platy zeolite on fracs, botryoidal pale gry blue to lt gry clay + zeolite? in cavities (≤2cm). Intermittent wht silica in ≤2mm vesicles (less common than clays, zeolites).

3559'-3561½' Amygdular b.a. w/ gry-grn clay >> wht silica as vesicle filling material. Silica clearly postdates clay.

3561½'-3571' consolidated breccia a/a, relatively unfracd w/ fracs @ 45°-75° w/ lt. clay shear locally, increase in clr zeolite abundance in available sm. vesicles (≤1mm) but still light amt. rare silica (5mm vn) @ base of interval. Fracs occurring w/ or w/o clay a/a. This is notably lighter than clay occurrence 100' uphole.

3571'-3576½' dense b.a. flow, fracs @ 30°-45° w/ lt. to no clay a/a. Lt. gry clay & zeol? in vesicles are common. Localized lt. to mod. wht silica (up to 30% of vesicles in one 1' interval). Common gry-grn clay filling vesicles & v. light amt. on fracs. Local mild clay silicification. V. Rare microscopic v.f. dissem. copper min.

3576½'-3577½' breccia w/ v. common clr zeol. & local sm silica vnlets

3577½'-3580' dense flow, lg. subvert. frac. (8" long) in mid-interval w/ lams grn-gry clay below turquoise-colored clay below clr drusy zeol. below opalescent to wht silica. Zeolite most abundant & lt. coatings of all, overall (<<1mm).

3580'-3600.5 consolidated breccia a/a, lt. frac w/ most common & @ 45°. Cmn. lt. amt. lt. gry botryoidal zeol/clay coating ≤4cm vesicles. @ 3581': start 1' rubbly interval. @ 3586' wht 1mm spheroidal silica w/ clay or fairly hard zeolite in frac. Local pH. clay silicification (grn-gry & mod brn in vesicles). Overall zeolites more abundant (lt-med) on fracs than clays. Rock still has plenty of open pore space for fluid movement (5-8% = ½ of available space before any 2ndary min deposition).

3577'

3597'

Diamond Shamrock
Thermal Power Company

CORE DESCRIPTION
40 FOOT INTERVAL

HOLE CTGH-1
FIELD CLACKAMAS/CASCADES
GEOLOGIST (S) GOODWIN/McDANNEL
BASIS BINOC. SCOPE (20X MAX) DATE 7/26/86

DEPTH INTERVAL	Fracturing	DESCRIPTION
3517'	ALL↓AML↓ML↓MLA↓LA↓L	**BASALTIC ANDESITE** 3517'-3532' RETURN TO DENSE BASALTIC ANDESITE LAVA: FINELY & SPARSELY PORPHYRITIC. PHENOS OF PLAG, PYX, OL? (IDENTICAL TO PREVIOUS LAVAS-SINCE 2965.6). INCREASE IN FRACTURING & CLAY OVER PREVIOUS INTERVAL (3438-3517'), FRACTURING FREQUENCY. SUB-VERTICAL & LESS COMMONLY, 45°. FRACTURE SURFACES HAVE LIGHT CLAY COATING: GRY BLU GRN, GRY GRN, PALE BLUE, WHT. PALE BLUE USUALLY COATS UNDERLYING GRY BLU GRN & MAY IN TURN HAVE A DRUSY COATING OF FINE ZEOLITES. CLAYS MAY EXHIBIT BOTRYOIDAL FORM. SiO_2 FORMS SHORT VEINLETS & OCCURS AS BLUE GRN IN VOIDS. V. RARE COPPER. MINOR SHEAR ON FRAC. SURFACES. 3532'-3538' VOLCANIC BRECCIA AS ABOVE IN 3438'-3517'. THIS INTERVAL CONTAINS GREATER RED BRN OXIDATION (PRIMARY). RARE FRACTURES @ 45° to ℄ w/ LT. SHEARING OF CLAY. COMMON PALE GRY GRN CLAY in FINE VESICLES w/ CLR, DRUSY, SLIGHTLY BOTRYOIDAL ZEOLITE ON TOP OF CLAY (Both < 1mm thick coatings), est. 10% of ROCK is VOIDSPACE w/ ~80% filled w/ CLAY & ZEOLITES in this interval. This is well above the average % of filled VOIDS.
3537'		
	ALM↓LA↓L	3538'-3546' VOLCANIC BRECCIA changes character: fractured dense dk. gry b.a. (pilotaxitic g.m., sparse & finely porphyritic w/ plag >> pyx + ol? phenos) with gry-grn clay ± ptlly silicified wht to bluish gry clay filling in the irreg, angular (≤1') cavities between r.f.s (that often fit together across the frac's - indicating less relative movement of r.f.s than upper unit @ 3532'). Inter r.f. material commonly is 2ndary. Irregular frac. attitudes w/ cmn. sinuous break. Drusy zeolites on clay a/a. Rare microscopic copper colored min. a/a. @ 3542' grn clay is covered by pale blue clay which is covered by a platy clr zeolite & an opaque wht spherulitic? or botryoidal zeolite in a ≤1cm vesicle. Uncommon 2-3mm wht silica vnlets. Overall lt. silica < zeolites < clays (which are v. lt on fracs. & lt to med. as void fillings)
3557'	ALA↓L	

Diamond Shamrock
Thermal Power Company

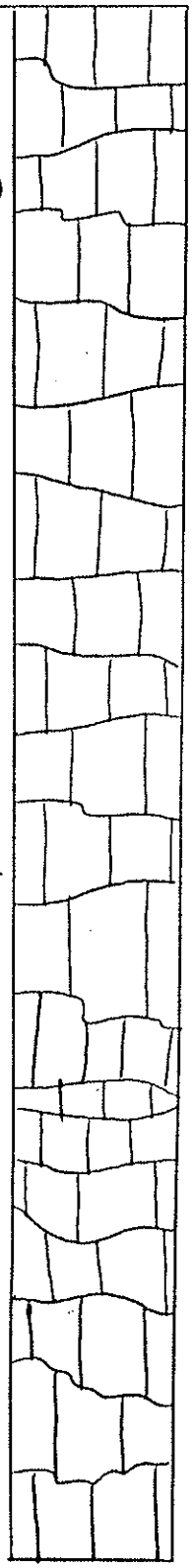
CORE DESCRIPTION

40 FOOT INTERVAL

HOLE CTGH 1 GEOLOGIST (S) GOODWIN/McDANNEL

FIELD CLACKAMAS/CASCADES BASIS binoc. 'scope DATE 7/26/86

DEPTH INTERVAL		DESCRIPTION
3477'	A ↓ M ↓ H	**BASALTIC ANDESITE (A/A)** 3480½' - 3492' Return to dense lava (finely porphyritic bsa. w/ 5% plag & pyx → gry grn clay, pilotaxitic g.m.) increasing silica (pale blue & milky) in voids and as (≤ 5mm thick x ≤ 30cm) vns filling common sinuous subvertical fractures, some of pale blue silica has botryoidal/mammillary texture and is hydrated/opalescent. Clay adjacent to silica in large (≤ 3-5 mm) vesicles is silicified (pt'lly). @ 3481' clr zeolite forms microstalactites in void above silica pooled at base of narrow 5" fracture, both form on top of grn clay 3492' - 3517' Return to VOLCANIC BRECCIA 3488' ROCK BECOMES VESICULAR & PASSES INTO VOLCANIC BRECCIA ~ 3492. (VOLCANIC BRECCIA COMPOSED OF LAPILLI & BLOCKS OF BASALTIC ANDESITE, COMMONLY SCORIACEOUS OR VESICULAR & MAY SHOW SUBTLE RED BRN OXIDATION, IN MATRIX OF BASALTIC ANDESITE), VESICLES FILLED W/ GRY BLUE GRN CLAY & PALE BLUE CLAY*, MNR WHITE CLAY, BLUE & GRN CLAYS MAY BE BOTRYOIDAL (NOT AS COMMON IN THIS INTERVAL AS ABOVE) & COATED W/ CLEAR, FINE, ZEOLITE*(PALE BLUE CLAY OFTEN COATS GRY BLUE GRY). MNR SILICA IN VOIDS & SUB-VERTICAL VEINLETS. TR. V. SOFT FOLIATED MINERAL. TR COPPER. CLAYS IN THIS INTERVAL APPEAR TO BE LESS THAN INTERVALS ABOVE (i.e. ~3385')
3497'	M A L A	
	M ↓ A L	
3517'		



CORE DESCRIPTION

40 FOOT INTERVAL

HOLE CTGH-1
FIELD CLACKAMAS/CASCADES

GEOLOGIST (S) GOODWIN/MCDANNEL
BASIS BINOC SCOPE DATE 7/25/86

DEPTH INTERVAL	DESCRIPTION
3437'	BASALTIC ANDESITE (A/A)
	3434'-3443' Return to volcanic breccia a/a, common pale yellow gry and very pale grn clay ptlly to completely filling 50-70% of sm. vesicles, larger vesicles (3-15mm) often contain clr zeolites as drusy coatings on lt. blue gry to lt gry botryoidal clay, opalescent silica is less common except in the largest cavities (≤2½cm) where it is selectively deposited, often in close association w/ wht clay eg. 3438' & 3441'. At 3438' silica fills a 1½cm cavity and 6" away a 2½cm cavity contains only botryoidal clay & the clr drusy zeolite.
	3443'-3451' Return to dense med gry b.a. lava, fracs. commonly @ ~75° & subvertical (& sinuous), clays occur a/a, silica restricted to 1 vein @ 3448' (2mm x 40mm, sinuous & subhorizontal), rare microscopic copper-colored metallic min. occurs as v.f. disseminated flakes on clays in fractures. Limonite mnr @ 3451'.
	3451'-3455' volcanic breccia w/ clays a/a, @ base of interval silica occurs in fracture above a 1mm layer of grn gry clay & below a 3mm layer of wht clay. Silica is 1mm layer & all are horizontal in partially-filled void.
3457'	3455'-3459' dense lava; platy partings @ 60° in middle of interval, lt. clay on fractures a/a, rare v. finely disseminated microscopic copper-colored min. occurring a/a; & blue gry to milky silica as short veins (≤1½cm x ≤2mm) & filling vesicles & associated w/ lt. blue gry and grn gry clays on fractures. Common botryoidal clr zeolite on dk gry grn clay in other vesicles. Clays >> silica > zeolite. Silica assted w/ subvertical fracture through this thin unit.
	3459'-3480½ Return to breccia; mod brn & gry grn clays in vesicles a/a, to 3471' intermittent v. lt. blue botryoidal silica assoc. w/ wht clay on frac & in larger (≤2cm) vesicles on top of gry grn clay, milky & pale blue varieties are commonly horizontally banded (1-5mm bands) in ptlly filled cavities, many voids remain v. lightly mineralized w/ gry-grn clays & drusy clr zeolite w/o silica, below 3469' subtle increase in clay content of matrix (gry grn) & in zeolites
3477'	

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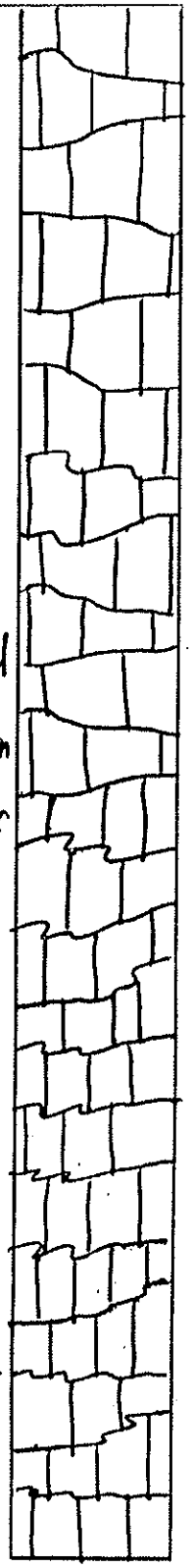


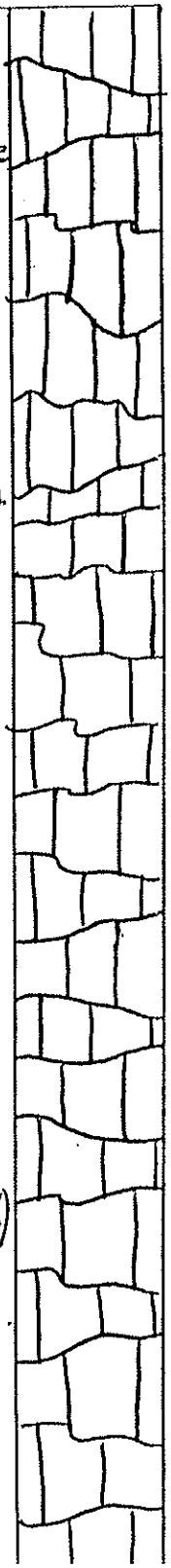
Diamond Shamrock
Thermal Power Company

CORE DESCRIPTION

40 FOOT INTERVAL

HOLE CTGH-1
FIELD CLACKAMAS/CASCADES
GEOLOGIST (S) GOODWIN/MCDANNEL
BASIS BINOCSCOPE DATE JULY 25, '86

DEPTH INTERVAL	Fracturing	DESCRIPTION
3397'	L A L A L A L A L A L I A L M A L M M L A A	**BASALTIC ANDESITE (A/A)** (pyroclastic) 3395'-3421' - Return to volcanic breccia - lapilli & blocks of scoriaceous/vesicular/dense basaltic andesite in basaltic andesite matrix. Vertical to sub-vertical fracture persists, w/lesser 60°-70°, but is not as intense as above. Common pale blue to v. pale blue clays on fracture surfaces & loving intergrain voids. Less common grayish blue grn clay (a/a), & gry blu grn & gry grn. Clays(?) often have fine botryoidal form & may or may not be coated by v. fine, drusy coating of soft clear mineral (zeolite?). Also, clear botryoidal mineral on frac. surfaces. Mnr silica. Sequence of clays loving voids: lt blue, green, clear mineral (a/a). Mnr copper mineral. 3399.5' - very soft, clear foliated mineral in small voids on cut surface of core = gypsum? Trace amounts. (zeolite) 3421'-3434.6' - return to dense, med gry, b.a. lava. Plag, pyx, ol? Most of mafic minerals → clay. Mnr flow banding produces fracture ~ 75°-80°. Silica veinlets ~ horizontal. Silica appears to be increasing on fracture surfaces, in voids & ≤1cm veins, often in botryoidal-mammillary form. Lt. blue & gry blue grn on fracs & in vessicles, voids. Less common gry grn clay. Trace copper colored mineral as described above (3365'-3395') occurs as thin, malleable flakes & as flat wire-like form.
3417'		
3437'		



Diamond Shamrock
Thermal Power Company

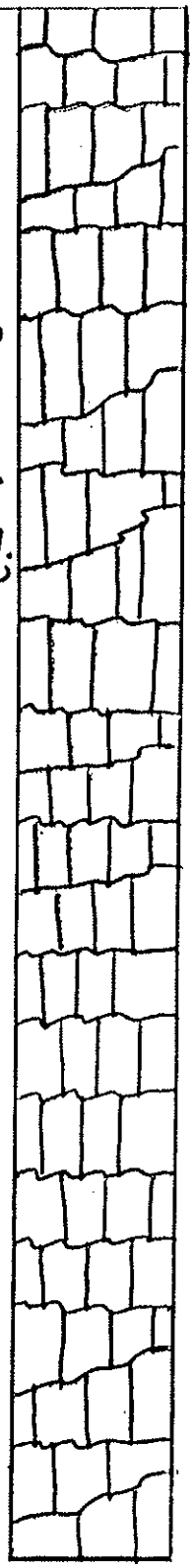
CORE DESCRIPTION

40 FOOT INTERVAL

HOLE CTGH-1 GEOLOGIST (S) McDANNEL/GOODWIN

FIELD CASCADES/CLACKAMAS BASIS binoc. scope DATE 7/24/86

DEPTH INTERVAL		DESCRIPTION
3357'	L ↓ M H L A	**BASALTIC ANDESITE (A/A)** 3356.5'-3360' dense flow w/ local platey parting, vesicular top, frac. variable, most common subvert. & irreg., lt. amt botryoidal pale blue gry to v. lt. gry zeolite? and clay on fracs. (v. soft coating) 3360'-3373' brecciated but consolidated, common scoriaceous r.f.s, v. lt. amt clay-zeolite botryoidal frac./vesicle coating a/a, v.f. clr drusy zeolite coating frac. @ 3373', vesicles commonly filled ptlly w/ mod. brn to gry grn clays 3373'-3379.5 gry-grn clay coating fracs., rarely sheared, frac. attitude commonly subvert to 75°, local yellow and orange oxide forms films adjacent to fracs & on fracs. in this dense flow interval; @ 3379.5' silica vn in assoc. w/ pale blue gry to wht clay in subvertical fracture
3377'	M ↓ H L L M L	3383'-3395' dense lava, rare v.f. disseminated copper-colored metallic flakes on botryoidal frac. coating of (zeolite?) & pale blue clay. Grayish blue grn, waxy clay & v. pale blue clay coat fracture surfaces, fill fractures & small voids. Mnr dusky yel grn clay, also. Mnr dusky yel ("glauconitic") & red brn oxidation stains follow hairline fractures. Microscopic, irridescent spots on fracture surface appear to be metallic, but are soft & break easily into small, thin plates of yel or org color. Vertical-sub-vertical &, less commonly, 60-70° fractures pervasive.
	A M L ↓ M ↓ M I H M	
3391'		

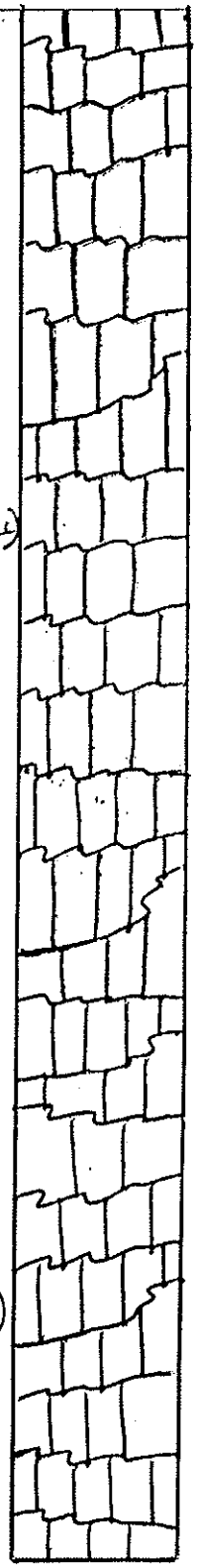


Diamond Shamrock
Thermal Power Company

CORE DESCRIPTION
40 FOOT INTERVAL

HOLE CTGH 1 GEOLOGIST (S) McDANNEL/GOODWIN
FIELD CASCADES/CLACKAMAS BASIS binoc. scope DATE 7/24/86

DEPTH INTERVAL	DESCRIPTION
3317'	BASALTIC ANDESITE (A/A)
	3319' microscopic, thin, malleable plates of copper-colored metallic mineral
	3324' R botryoidal silica in void w/ lrn gry clay, vertical fracture at this interval w/ coating of botryoidal dusky yellowish grn clay overlain(?) by dusky grn clay w/ drusy coating of soft, clr, microxtalline (zeolite?) mineral. common pale blue clay. R. v. fine disseminated phyllosilicate - dk. grn to dk grey ... chlorite?? (SUPERFICIAL MATERIAL WASHED INTO DRILL HOLE, ACCOMPANIED BY FINE SAND.
	3329' R copper-colored mineral occurring as @ 3319', lt. shear of fracs @ 15°-30° w/ lt. to mod. amt lt gry to lt. bluegry clay
3331'	3335'-3337.5' dense lava, @ 3335' (≤ 2cm voids) w/ clr. silica ptlly filling voids on top of botryoidal gry-grn clay (+ zeolite?)
	3337.5'-3339' brecciated a/a, no unusual mineralization
	3339'-3352' dense lava w/ pilotaxitic grn texture, plag & pyx phenos., unit v. frac'd to 3347' w/ fracs @ subvert. to 75°, lt. blk to gry-grn clay (w/ shear) on fracs, orange & yellow oxides form films on fracs. and (≤ 6") halos in unfrac'd rock below 3345'
	3350' microscopic, thin, irregular golden flecks (tarnished w/ lt. grn) - unidentified metallic min. occurring as v. finely disseminated grains on fracture surface w/ clays. (NATIVE COPPER)
3357'	



Diamond Shamrock
Thermal Power Company

CORE DESCRIPTION

40 FOOT INTERVAL

HOLE CTGH1 GEOLOGIST (S) McDANNEL/GOODWIN

FIELD CASCADES/CLACKAMAS BASIS binoc. microscope DATE 7/24/86

DEPTH INTERVAL	DESCRIPTION
3277'	**BASALTIC ANDESITE (A/A)**

A series of thin (3'-15') layers of massive dense porphyritic lava and consolidated breccia intervals (breccia (pyroclastic) intervals commonly consist of med gry subrounded lapilli sz lava rock fragments in a red brn to mod. brn matrix of ash sz r.f.s and xtals of pyx & plag). Brecciated intervals are commonly thicker, less fractured, & often have less secondary mineral deposition in available voids. The breccia is commonly porous but pervasive lt. to mod. matrix clay alteration may result in less permeability than the dense lava which has less porosity (though it is commonly vesicular at borders) but is usually lightly to moderately fractured. Apparently the interconnection of these fractures is fairly good. Light amounts of clay (a/a) & zeolites & rare quartz veins are found in the unbrecciated but fractured dense lava intervals.

3279'-3289' breccia a/a, unfrac'd w/common scoriaceous r.f.s, lt-mod. lt.gry to mod brn clay, intermittent ptl to complete filling of vesicles by clay

3289'-3293' dense lava w/lt. amt lt. gry to lt. blue gray clay ± v.lt. amt lt.grn/clr botryoidal zeolite on clay

3293'-3302' same as 3279'-3289' - volcanic breccia

3302'-3308' dense lava, platy frac. @ 75° to ℄ and less common vertical fracture with lt. amt. lt. blue gry & gry grn clays

3308'-3334½' Volcanic Breccia

3297'

3317'

Diamond Shamrock
Thermal Power Company

CORE DESCRIPTION

40 FOOT INTERVAL

HOLE CTGH-1
FIELD CASCADES/CLACKAMAS
GEOLOGIST (S) GOODWIN/McDANNEL
BASIS BINOC. MICROSCOPE DATE 7/23/86

DEPTH INTERVAL	DESCRIPTION
3237'	BASALTIC ANDESITE (A/A)
	3244' - 1 vein opalescent pale blue qtz in frac previously coated w/ clay s/a
	3246' - 3248.5' ~VERTICAL TO 45° FRACTURE
	3248' - TR DISSEMINATED V. FINE, THIN, SOFT, GOLD-COLORED MINERAL ON FRACTURE W/ ZEOLITE & BLUISH GRY CLAY
	3252.5'-3257.5' irregular sub vertical & 30° fractures w/ botryoidal ltgry to ltbluegry to pale grn clay (± v.lt. zeolite - less common), rubbly @ 3254'-3255' (in dense lava unit)
3257'	3257.5'-3263' : consolidated breccia w/ finely scoriaceous r.f.s. (≤ 1.5cm voids) w/ v.light amt. clay (exc. pervasive matrix clay alteration - mod. amt.)
	3263'-3267' dense lava, common fracturing w/ increased amt. clays (lt brn, still v light): wht & pale grn & pale blue (± pale grn/ clear zeolite) coating fractures, R opalescent quartz in vn @ 3265', vesicles & pits intermittently ptly to completely filled w/ clay s/a
	3274'-3279' dense lava, commonly frac'd @ 30°-45°, very light amt. clay for dense lava interval; no intense fracturing
3277'	

LAVA LAML MHAML AHL LAML

Diamond Shamrock
Thermal Power Company

CORE DESCRIPTION

40 FOOT INTERVAL

HOLE CTGH1
FIELD CASCADES/CLACKAMAS

GEOLOGIST (S) MCDANNEL/GOODWIN
BASIS binoc. microscope DATE 7/23/86

DEPTH INTERVAL	Fracturing	DESCRIPTION
3197'	H M A ↓ L A M L ↓ M ↓ L M L	BASALTIC ANDESITE (A/A) a series of thin (3'-15') layers of massive med gry porphyritic lava & brecciated but consolidated intervals of commonly med gry subrounded lapilli-sz r.f.s of b.a. in a red brn to mod brn matrix of ash sz r.fs & Xtals of plag & pyx. 3197' Subtly brecciated but cons. b.a. a/a, common scoriaceous r.fs, v. lt. amt. pale blue/wht (dry) clay on fracs & in voids, common lt. matrix clay alt., frac. & most common = vertical (sinuous & irreg. break) 3205.5' ZEOLITES COMMON AS DRUSY COATING OVER/ON BLUISH GREY CLAY ON FRACTURE SURFACES & IN VOIDS
3217'	L ↓ A ↓ L M	3214'-3240' VOIDS UP TO 5 CM COMMONLY/THIN CLAY COATINGS, ± ZEOLITES.
3237'		

CORE DESCRIPTION

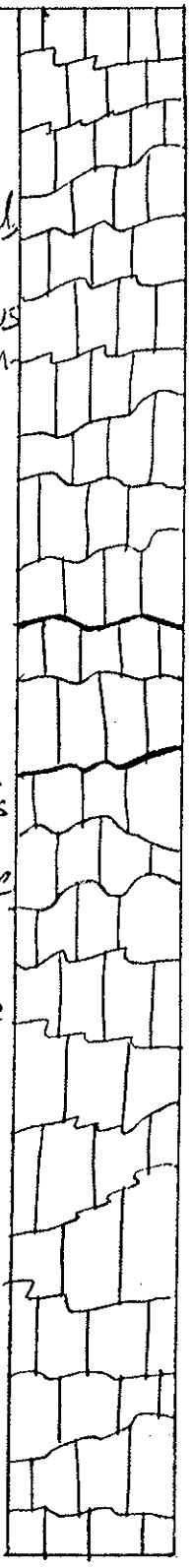
40 FOOT INTERVAL

HOLE CTGH 1
FIELD CASCADES/CLACKAMAS

GEOLOGIST (S) McDANNEL/GOODWIN
BASIS binoc. 'scope DATE JULY 23, '86

DEPTH INTERVAL	*Fracturing	DESCRIPTION
3157'	LMI↓HML↓ALA↓LML	**BASALTIC ANDESITE (A/A)** 3157'-3161.5' med dk gry, unbrecciated, dense, sparsely porphyritic (plag & pyx phenos.), pilotaxitic g.m., often intensely frac'd., common lt. coating pale blue gry (dry) & wht (& dk gry grn (wet)) clay on fracs & coating vesicles, rare vnlets clay + quartz, clay commonly botryoidal, most common fracs @ 30° & ~vertical 3161.5'-3173' brecciated & consolidated lapilli- & blk-sz'd scoriaceous b.a. in or-to red-brn matrix a/a, clast-supported except at boundaries of interval where matrix% exceeds 50%, decrease in fracturing & clays
3177'	ALA↓LML	3173'-3177' dense & unbrecciated, frothy top w/ decrease in vesicles w/ depth, lt. frac. w/ predom. fracs @ 30° & 60°, lt. clays a/a (@ 3157'), 2cm breccia seam in middle of unit, rare plag-pyx clots (≤0.5cm) Unit may represent a single thin flow. 3177'-3181.5' brecciated but consolidated (same as 3161.5') finely scoriaceous lt fs 3181.6'-3184.5' dense basaltic andesite, fracs @ 15°-45° near basal rubbly zone
	↓LMI↓ALA↓LMH	3184.5'-3189.5' brecciated but consolidated, no scoria, botryoidal pale blue clay in voids (light), rare vertical veinlets w/ clr zeolites, increase in gry grn matrix clay in basal ½ of unit, lt. shearing of 1-45° frac 3189.5'-3197' dense, generally unbrecciated, local alignment of sm pits filled w/ clay @ 45° = incipient platy parting?, fracs variable: sinuous sb vertical most common w/ lt. amt. wht/pale blue clay (botryoidal), large (≤2") angular voids basal 1½' of unit, partially filled w/ wht botryoidal silica (= clay + silica), minr silica vnlets
3197'	H	

*Fracturing: A=absent L=light M=moderate H=heavy I=intense



Diamond Shamrock
Thermal Power Company

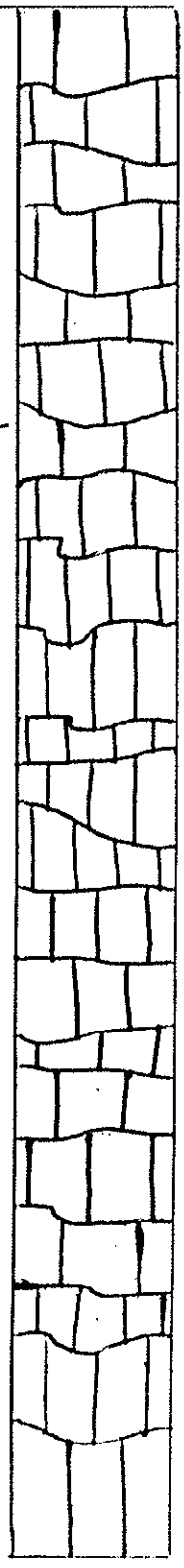
CORE DESCRIPTION

40 FOOT INTERVAL

HOLE CTGH-1
FIELD CASCADES/CLACKAMAS

GEOLOGIST (S) GOODWIN/McDANIEL
BASIS BINDZ SLOPE DATE JULY 22nd, '86

DEPTH INTERVAL	DESCRIPTION
3117'	BASALTIC ANDESITE (A/A)
	3122'- FRACTURING & CLAY DECREASE
	3126'- VOLCANIC BRECCIA ROCK RESUMES PREVIOUS COLOR (MED DK GRY-DK GRY) & BECOMES SCORIACEOUS AGAIN – MNR RD BRN SCORIA IN BASALTIC ANDESITE LAVA. MNR PALE BLUE CLAY.
3137'	3140'- ROCK BECOMES LT-MED GRY, DENSE; INTENSIFIED FRACTURING W/GRYISH GRN & GREENISH GRY CLAYS (AS ABOVE @ 3114-3126).
	3146'- AS ABOVE @ 3126'
	3148'- COATING OF BOTRYOIDAL SILICA ON FRACTURE/VOID WITH WHT CLAY INTERLAM'S PTLLY FILLING VOID
3157'	@ 3154' conjugate fracture set @ 15°∡ to ℄ & sinuous vertical fracture, slt. increase clay, consolidated v. poorly



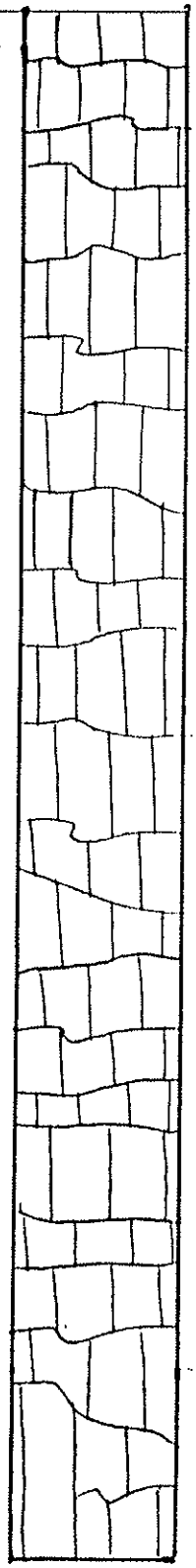
Diamond Shamrock
Thermal Power Company

CORE DESCRIPTION
40 FOOT INTERVAL

HOLE CTGH 1
FIELD CASCADES/CLACKAMAS

GEOLOGIST (S) McDANNEL/GOODWIN
BASIS binoc. microscope DATE JULY 22, 1986

DEPTH INTERVAL	Fracturing	DESCRIPTION
3077'	I ↓ L A L ↓ I L ↓ I L ↓	**BASALTIC ANDESITE (A/A)** brecciated but consolidated b.a. blocks (much less common) & lapilli-sz r.f.s in mod brn to red brn matrix a/a, generally light fracturing (often irregular), light pale blue & dk gry grn clays in vesicles and coating fractures, common scoriaceous texture, locally rubbly & light clr zeolite in vesicles, pervasive lt. matrix clay alteration 3076'-3079' : rubbly, vertical frac intersecting irreg. break 1 to± in fragile/scoriaceous interval, slt. increase brn clay 3087'-3088' rubbly
3097'	A L ↓ A L I M ↓	3107' - ROCK BECOMES LT-MED GRY, DENSE — i.e. NO LONGER SCORIACEOUS. FRACTURING PREDOMINATELY VERTICAL, LESS COMMONLY 45°
3117'	A ↓ L I L ↓ M ↓ L M H ↓	3114' - FRACTURING INTENSIFIES. GRAYISH GREEN CLAY V. COMMON ON FRACTURE SURFACES & IN CRACKS & SMALL VOIDS. FRACTURING PREDOMINATELY VERTICAL TO SUB-VERTICAL, LESS COMMONLY 45°.



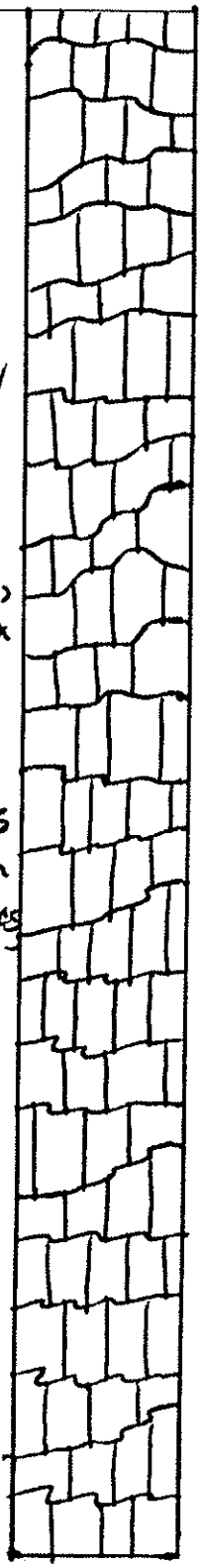
CORE DESCRIPTION

40 FOOT INTERVAL

HOLE CTGH-1
FIELD CASCADES/CLACKAMAS

GEOLOGIST (S) GOODWIN/MCDANNEL
BASIS binoc. microscope/ DATE JULY 21, 1986

DEPTH INTERVAL	Fracturing	DESCRIPTION
3037'	M L ↓ M L ↓ I ↓ M L A ↓ L L H I ↓ H ↓ I ↓ H M L ↓ A M ↓ A L ↓ I ↓	**BASALTIC ANDESITE (A/A)** rock fragments commonly porous & scoriaceous, fractures easily, brecciated but consolidated, most common frac. @ 45° w/ no shearing, v. lt. pale blue & dk grygrn clay in frac's., common unfilled vesicles (≤ 1.5cm) overall v. little alteration exc. lt. clay alteration of matrix & pyx → clay 3047½'-3048½' Rubbly interval, several vertical fracs. w/ one continuing to 3051', mod. brn clay (easily washed away) 3054'-3069' Scoriaceous rock absent through interval, @ 3054' rock becomes matrix-supported w/ increase matrix 3057'-3067' unbrecciated med. gry basaltic andesite, commonly rubbly w/ sinuous vertical - subvertical fractures & frac @ 40°, light clay (pale blue, dk grygrn) on fracs which often have irreg. break, v. light drusy zeolite in voids/fracs pervasive light matrix clay alteration (grygrn) @ 3067' return to brecciated but consolidated blocks & lapilli-sz b.a. in red brn matrix (A/A), commonly scoriaceous, little alteration exc. light clay alteration of matrix, frac @ subvertical & 45° w/ no or v. light pale blue & grygrn clay 3068½'-3072½' 8" intensely oxidized red brn scoria followed by brn.gry → med gry unbrecciated b.a. A/A (contact?)
3057'		
3077'		



Diamond Shamrock
Thermal Power Company

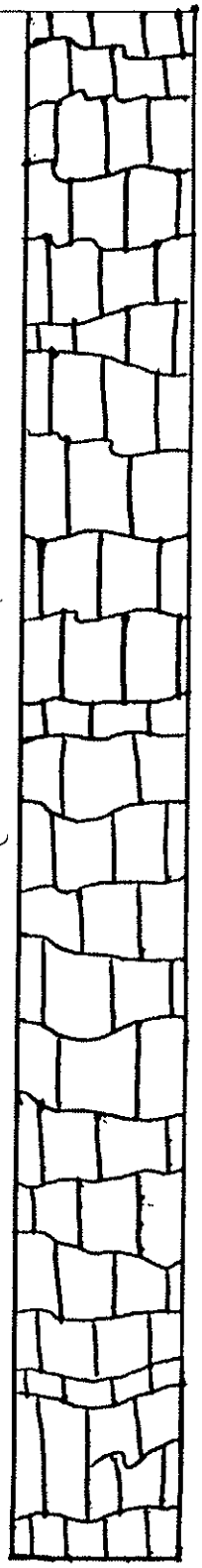
CORE DESCRIPTION

40 FOOT INTERVAL

HOLE CTGH1
FIELD CASCADES/CLACKAMAS

GEOLOGIST (S) McDANNEL/GOODWIN
BASIS binoc. microscope DATE July 20, '86

DEPTH INTERVAL	Fracturing	DESCRIPTION
2997'	L M L M L A L H M H L	**BASALTIC ANDESITE (A/A)** below 2998½' mottled appearance, brn gry & dk gry B.A. lapilli sized frags. in orange brn to red brn matrix a/a, sparsely porphyritic (fewer pyx.) (This feature ends ~3001', when flow becomes med. dk grey.) (Pyroclastic breccia) 3003' rock appears more open textured. Increase in vesicles. Clays (grn gry; pale blue, gry grn) fill vesicles & intergranular voids. 3014' - began to find yellowish grn - gry grn inclusions (2-4 cm) composed of pyroxene & minor plagioclase + clay (green). 3016½' rock becomes slightly scoriaceous & becomes increasingly scoriaceous by 3018', showing red brn oxidation. Rock is slightly less consolidated & breaks easily. (Pyroclastic breccia interval)
3017'	M L M L M M H	
3037'		



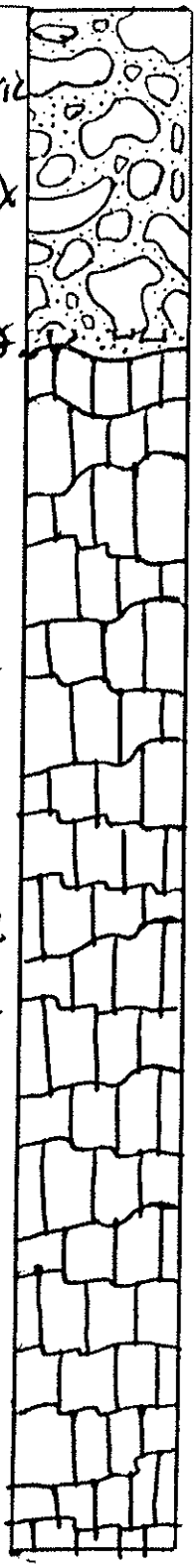
CORE DESCRIPTION

40 FOOT INTERVAL

HOLE CTGH1
FIELD CASCADES/CLACKAMAS

GEOLOGIST (S) McDANNEL/GOODWIN
BASIS binoc. microscope DATE July 20, 1986

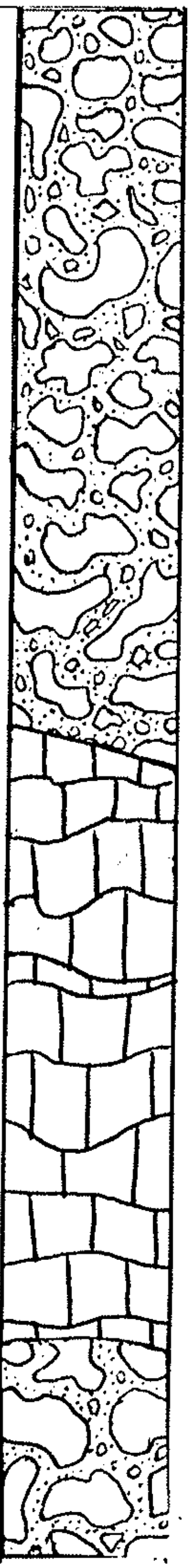
DEPTH INTERVAL	fracturing	DESCRIPTION
2957'	I	VOLCANIC BRECCIA (A/A) Angular to sub-angular lapilli sz clasts of porphyritic-aphyric mafic to intermediate lavas ±, less commonly, ltgry to v.lt. gry clasts (some nowclay) which may be more silicic. Matrix is greenish blk coarse to fine ash sz rock frags. a/a. Unit is predominately clast supported. Graded bedding at 2954' & 2956'. Unit is v. fractured, usually along subvertical to 30° ∡ Polished, sheared surfaces. Minor pale grn & pale blue clays on frac. surfaces.
	M H I	
	L	2965.5' BASALTIC ANDESITE med gry to dk gry to brngry, finely & commonly sparsely porphyritic (2-5%), phenos: plag ^PH^ wht clay, pyx → grn clay, common mottled appearance, due to brecciated but consolidated rock: dk gry to brnish gry sm. blocks & lapilli-sized B.A. frags. (w/generally disaggregating boundaries) blend into matrix (orange brn to red brn) of ash sz B.A. frags, xtals plag & pyx, &, bright orange, wht, & red brn clays. Mottling is more subtle and matrix is sparse above 2979'. Below 2979' matrix increases to 20%-50% and fine fracturing of lapilli w/ sm. vnlets wht clay is common. Pervasive mod. matrix clay alteration. Fractured intervals w/ shear surfaces, typically 30°-45° ∡. V. Mnr gry grn clay on surfaces.
2977'	M H I	2979½'-2984' intermittent rubble, 30°-45° fracs most common w/ irreg breaks ⊥ to ∡
	M L	2994'-2998½' basaltic andesite interval, unbrecciated - w/ soft lt. gry clay in vertical fracture at 2994', mod. clr drusy (& coating) zeolite on fractures
2997'		



CORE DESCRIPTION
40 FOOT INTERVAL

HOLE: CTGH 1
FIELD: CASCADES/CLACKAMAS
GEOLOGIST (S): McDANNEL/GOODWIN
BASIS: binoc microscope DATE: July 20, 1986

DEPTH INTERVAL	Fracturing	DESCRIPTION
2917'	L A L ↓ M H M ↓ H L ↓ A M H I H M L I L ↓	VOLCANIC BRECCIA (A/A) 2916½ matrix color varying from dusky yel. grn to dk yel. brn w/ both matrix & clast-supported intervals 2925' matrix color: dk yel. brn, matrix appears to flow around larger constituents in matrix-supported interval; hot & fluid deposition suggested 2930'-2933' Vertical fracture present w/ rubble at base of interval 2935' reverse graded base of breccia unit: ash-sized & lapilli rf.s, lightly sheared @ 45° to ℄ w/ brn clay vn along shear (= fault contact?), crudely bedded @ 90° to ℄ 2934'-3935' laminae & thin beds of predominately ash sized rock fragments. Bedding is horizontal to ~45° ∠ ℄.
2937'	A L A ↓ L A ↓ L M ↓	2935' BASALTIC ANDESITE Md gry to dk md gry, finely & sparsely porphyritic (≤1%), phenos: plag, pyx. Rock has mottled grey appearance. Grades into oxidized mod (@2933) red & med gry: flattened, elongated, irregular disrupted margins of wk dk gry basaltic andesites in oxidized basaltic andesite. (Pyroclastic mat.!)
2957'	I ↓	2951.5' VOLCANIC BRECCIA (see following page)

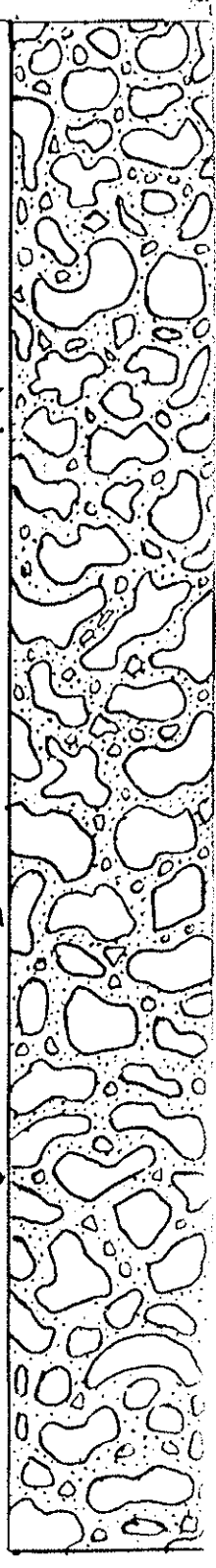


Diamond Shamrock
Thermal Power Company

CORE DESCRIPTION
40 FOOT INTERVAL

HOLE CT611-1
FIELD CASCADES/CLACKAMAS
GEOLOGIST (S) GOODWIN/MCDANIEL
BASIS binoc. microscope DATE July 19, '86

DEPTH INTERVAL	Fracturing	DESCRIPTION
2877'	I L A L H M L I H M I A L M I M H I L A	VOLCANIC BRECCIA (A/A) 2865.5' cont'd: Clasts show plastic deformation. Oxidized reddish matrix shows minr banding (as if deposited in molten state) 2876' - sheared & broken. Sheared, waxy surfaces. Variable shear/fracture angles. 2877.5'-2879' small lapilli sz gry & dk red brn rock frags (heterolithologic) in minor matrix of dusky yel-dk yel org clay (palagonitic?). Thin bedding, laminations @ 2876-2877. 2878'-2880' unit v. sheared & broken, predominately along short high angle fractures. waxy, sheared surfaces 2880'-2897' dk yel brn to dk yel orange matrix, interval characterized by two interbedded units grading into one another repeatedly: (1) a lapilli-rich interval w/ 2-25 mm rounded lapilli, mainly dk. yel. brn & altered to clay & (2) larger more angular lapilli of mafic & intermed comp. in a matrix of v. fine ± palagonitized rfs & clay (wht) w/ minr xtals pyx, plag., FeOx (blk min). Rare frac @ 30° to & w/ lt. shearing of clays & v. rare zeolites
2897'		2896'-2903' sinuous subvertical fracture & poorly developed 30° conjugate fracture set (locally), lower ½ is rubbly, common shearing on fractures, v. lt. wht & grn gry clay Below 2897'-2955': matrix color dusky yellow grn, change in Fe oxidation state?
		2906'-2907' thin interval with characteristics of hot deposition: blk & reddish gry matrix w/ v.f. palagonitized rfs & smaller lapilli among larger basaltic andesite lapilli/blocks
		2909'-2916½' Several rubble zones (≤ 2' thick) in interval, matrix color: dirty brn, rock has v. irreg. break & is sometimes friable, probably shear-related condition. v. lt. clays & zeolites in fracs. (v. rough conj. frac set @ 35°)
2917'		



Diamond Shamrock
Thermal Power Company

CORE DESCRIPTION
40 FOOT INTERVAL

HOLE: CTGH 1
FIELD: CASCADES/CLACKAMAS
GEOLOGIST (S): McDANNEL/GOODWIN
BASIS: binoc. microscope
DATE: July 19, 1986

DEPTH INTERVAL	DESCRIPTION
2837'	BASALTIC ANDESITE (A/A) 2838' flow becomes oxidized & grayish red. Flow breccia appears by 2840.5. Decrease in fracturing & clays 2841.25'-2844': very fractured/broken. Vertical to sub-vertical fracture angle predominate. Drusy zeolites. 2842' VOLCANIC BRECCIA (explosive origin?) Rock changes character, often over short intervals, but is predominately composed of angular to sub-rounded lapilli &, less commonly, blocks, of md gry to dk gry mafic-intermediate lavas in a dk gry-brn gry to gry red matrix of smaller rock fragments a/a v.fine material → clay, & xtls. Clasts are typically heterolithologic. Unit varies from clast to matrix supported. Short intervals of dk gry basaltic andesite(?) showing evidence of deposition while still in a plastic, partially molten state (juvenile) (i.e. disrupted margins, flattening, stringers, mnr banding) in oxidized (primary) reddish brn matrix. Near top of unit there is crude, subtle, discontinuous bedding in matrix. Rare zeolites filling hairline fractures/cracks, mnr drusy coatings on frac. surfaces. Fracture variable, but most often at high angle or ~45°. gen. light.
2857'	2860.75'-2863' dk gry porph basaltic andesite, predom lapilli sz, showing plastic deformation (see above descrip) in fine pale brn matrix → clay + smaller basaltic andesite frags. 2863.5' - heterolithologic clasts predom. mafic to intermed composition but include grey, silicic?, & altered porphyritic lt grayish green, & finely banded (rextalzed?). Some
2877'	

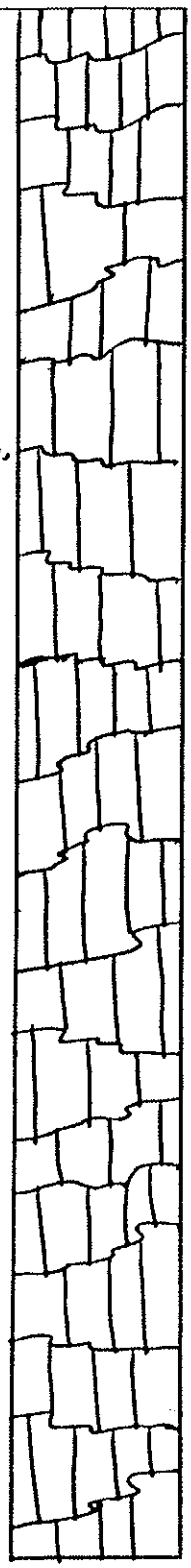
CORE DESCRIPTION

40 FOOT INTERVAL

HOLE CTGH 1
FIELD CASCADES / CLACKAMAS

GEOLOGIST (S) McDANNEL / GOODWIN
BASIS Binoc. Microscope DATE JULY 19, 1986

DEPTH INTERVAL	DESCRIPTION
2797'	BASALTIC ANDESITE (A/A) (med dk gry, finely porphyritic, phenos: pyx, plag, & ol.? light to moderate fracturing, most commonly 20° to 45° to ℄ with local sinuous vertical fracture. Pale grn & wht clays on fracture surfaces (often slightly waxy), typically showing minor shearing. V. short intermittent brecciated but consolidated intervals w/ clay vnlets ± rare zeolites (clr). 2806'-2810' intensely fractured @ 30° ℄ to ℄ to vertical, splintery rock fragments ≤ 1"-6" long, heavy waxy shear ± clear zeolite ± pale grn/wht clay on sinuous to planar fracs.
2817'	
2837'	



CORE DESCRIPTION

40 FOOT INTERVAL

HOLE CTGH-1
FIELD CASCADES/CLACKAMAS

GEOLOGIST (S) GOODWIN/MCDANNEL
BASIS BINOX. SCORE DATE JULY 18, 1986

DEPTH INTERVAL	DESCRIPTION
2757'	BASALTIC ANDESITE (A/A) (MED DK GRY, FINELY PORPHYRITIC: PHENOS OF PLAG, PYX, OL? FRACTURING LIGHT TO MODERATE, 20° TO VERTICAL. PALE GRN & DK GRYISH GRN CLAYS ON FRACTURE SURFACES, TYPICALLY SHOWING MNR SHEAR)
2777'	2782'-2786' ROCK BECOMES BRECCIATED (TECTONIC), BUT IS WELL CONSOLIDATED BRECCIA FRAGMENTS ARE ANGULAR, CLOSELY SPACED, & SLIGHTLY ELONGATE (DUE TO FRACTURE DIRECTION) ALONG VERTICAL-SUBVERTICAL AXES. NOT MUCH MOVEMENT ALONG FRACTURES. MNR CAVITIES W/ ZEOLITE. MNR MATRIX BETWEEN FRAGS OF DK GRYISH GRN CLAY, & LESS COMMONLY, WHT ZEOLITE. FORMING ≤ ½ cm seams on 30° to 45° joints with waxy shear (minor) towards base of interval.
2797'	

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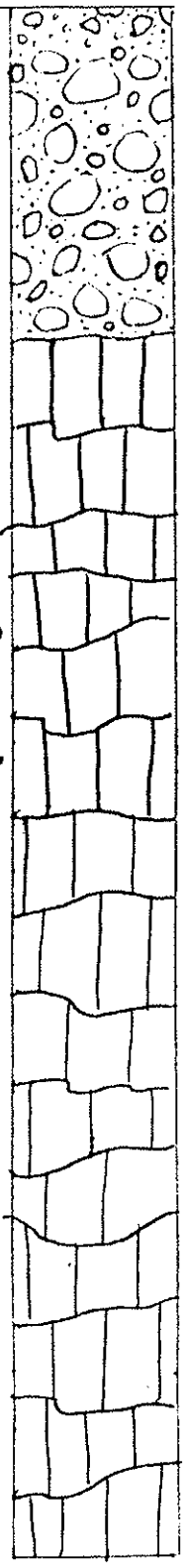
Diamond Shamrock
Thermal Power Company

CORE DESCRIPTION
40 FOOT INTERVAL

HOLE CTGH 1
FIELD CASCADES/ CLACKAMAS
GEOLOGIST (S) McDANNEL/GOODWIN
BASIS binoc. macro-scope DATE July 16, 1986

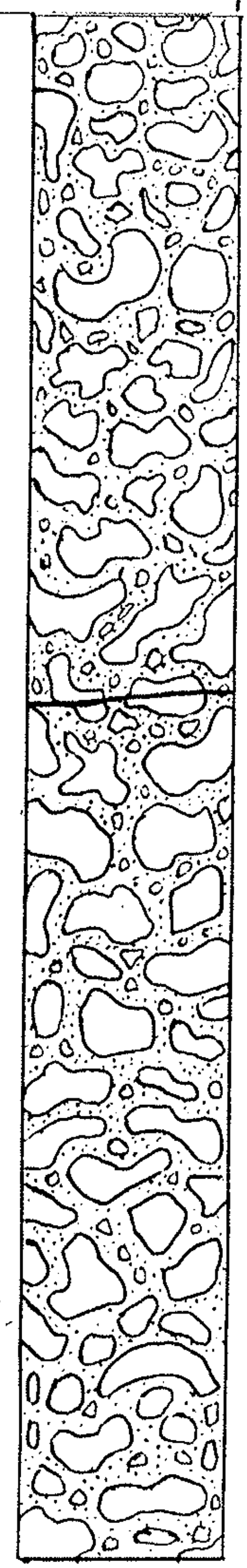
DEPTH INTERVAL	DESCRIPTION
2717'	VOLCANIC BRECCIA (A/A)
	2718' 12cm of dusky yellow to lt. olive brn v. fine ash-sz. f.s and xtals. Palagonitic? Rare lapilli-sz. clasts.
	2718.5' - Volcanic Breccia A/A @ 2694' with slight increase in clasts, mainly from b.a. unit beginning @ 2726'. Matrix color changes from dusky yellow to med. dk gry by 2719'. Rare clr. zeolite veins.
2726'	BASALTIC ANDESITE
	MED DK GRY, V. Finely porphyritic (7-8%). PHENOS: PLAG, PHX → CLAY, ol? LIGHT-MOD fracturing. Long (0.3m+) vertical to 20° fractures coated w/ pale grn & grysh grn, waxy clay. fracture surfaces show minor shearing.
	2726'-2736.5' - flow top breccia: dk gry - gry brn - red brn porphyritic basaltic andesite (25cm - 1cm) fragments, often elongated/banded & disrupted, in mod red brn clayey matrix w/xtls, subtle banding.
2737'	2736.5'-2748' rock becomes pale red brn, less breccia, mnr cavities w/ drusy zeolite. Zeolites also fill hairline fractures.
	2748' - rock becomes med dk gry as described above.
2757'	



CORE DESCRIPTION
40 FOOT INTERVAL

HOLE CTGH-1
FIELD CASCADES/CLACKAMAS
GEOLOGIST (S) McDANIEL/GOODWIN
BASIS binoc. microscope DATE July 18, 1986

DEPTH INTERVAL	fractures	DESCRIPTION
2677'	L ↓ M L ↓ A ↓ L M A ↓ L A L	ANDESITE BRECCIA (A/A) 2690'-2694' Notable increase in vesicularity & veside size (≤4cm) in scoriaceous blocks. Light amt. drusy zeolites and +/- pale grn gry/wht clay in voids. Contact marked by 23cm of (overall) brn grey coarse ash-size red brn, med gry, & dk. gry rock fragments, xtals, & mnr. ash(?). Interval is normally graded & crudely bedded/laminated @ 70°∠.
2697'	↓ L M L M A A ↓ L ↓ A ↓	2694' VOLCANIC BRECCIA Lt. olive gry to dk yellowish brn, lt. to med gry blocks & lapilli-sz r.f.s. of mafic to intermediate composition in a matrix of ash-sz r.f.s., xtals (mnr.), dusky yellow to dk yellow palagonite, & v. fine ash(?). Minor localized crude bedding (thin beds) in matrix. Matrix --> clay @ 2694' contact marked by ~23 cm of ash sz rock fragments, xt!s & minor ash. Interval is normally graded & crudely bedded & laminated, ~70° angle. (BLAST DEPOSIT?) 2710' Percentage of rock fragments in unit decreases 2712'-2718½' Small lapilli- to coarse ash-sz dk gry to dk gry brn rock fragments in matrix of dk. yellow orange palagonite and mnr. xtals. R.f.s often appear elongated & disrupted, as if deposited in a partially molten state. Subtle bedding based on clast size & matrix % variations. Blast deposit origin? Palagonite tuff?
2717'		

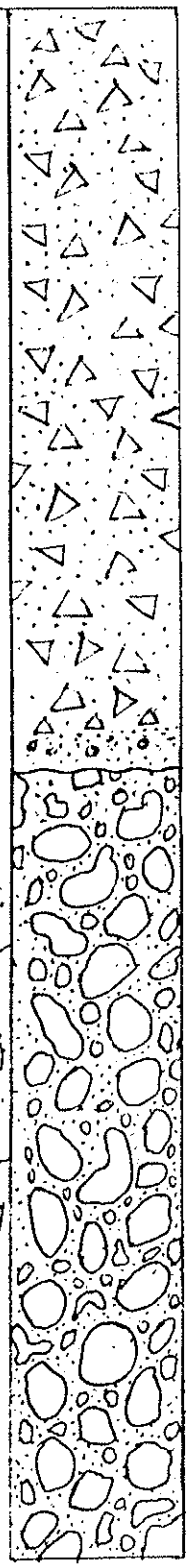


Diamond Shamrock
Thermal Power Company

CORE DESCRIPTION
40 FOOT INTERVAL

HOLE CTGH1
FIELD CASCADES/CLACKAMAS
GEOLOGIST (S) McDANNEL/GOODWIN
BASIS binoc. microscope DATE July 17, 1986

DEPTH INTERVAL	formation	DESCRIPTION
2637'	LAPILLI	LAPILLI TUFF (A/A)
		2654½' unit becomes lt. grey & horizontally-flattened lapilli (v. lt. grey, = fiamme?) increase
		2656½' A 6cm thick well-sorted layer of lt. gray coarse ash- to sm. lapilli-sized rock fragments with common wht & grn clay alteration followed by a 14cm thick bed of lt. gry consolidated ash-size fragments w/ sparse vesicular andesite lapilli.
2657'		2657' ANDESITE BRECCIA med to med dk gry angular to subrounded lapilli & blocks (≤4') of porphyritic andesite (pyx → dk grn gry clay, ± plag. : 2-4%), in lt. yel brn to lt. olive brn to lt. red brn matrix of ash-size 1% mnr. xtals w/ common voids. Unit is a series of intervals of primary (i.e. vol.) breccation (with vesicular lapilli & matrix) interspersed w/ blocks (v. thin flows?) unvesiculated andesite w/ mnr. secondary/tectonic? fracturing (and may represent a margin sample of thin flows) Mnr wht clay in vesicles.
	MIMLA	2657'-2675' Zeolites commonly form drusy linings on intergranular voids & vesicles, cementing the rock together & suggesting laterally extensive interconnected fractures.
		2657'-2659' Rapid decrease in matrix fraction. Below top 2' breccia is clast-supported.
		below 2675' Decrease in matrix voids & zeolites (clr/wht)
2677'		



CORE DESCRIPTION
40 FOOT INTERVAL

HOLE CTGH1
FIELD CASCADES/CLACKAMAS

GEOLOGIST (S) McDANNEL/GOODWIN
BASIS binoc. microscope DATE July 17, 1986

DEPTH INTERVAL	DESCRIPTION
2597'	Crystal-Lapilli Tuff (A/A)
	2602.5 Lapilli Tuff (Ash-flow origin?)
	Lt gry angular to sub-rounded lapilli sz rock fragments & black glass (fresh) in med gry to dk med gry matrix of ash sz rock fragments, xtls & glomeroxts of plag, opx & magnetite, glass fragments, minr clay. Rock fragments are predominately porphyritic andesite but include rare gabbroic samples (cumulate?) Elongated, black, fine-textured features are common & are reminiscent of collapsed pumice, but may be depositional feature. Unit is mod. well-consolidated & predominately massive. Bedding & sorting are present but uncommon → suggests possible surge deposition, in part.
	2604 ~0.3 m well sorted thin beds of coarse to fine ash sz material.
2617'	2605 rare blocks & larger lapilli in uppermost part of flow disappear by this interval. Small lapilli only are now present.
	2612' - decrease in lapilli sz rock fragments to ~ ≤3% throughout remainder of unit
	2624' - lapilli sz frags almost absent
	2630.5' - 2642' interval unit is poorly consolidated/friable in much of this
2637'	TALLAILA IALA LAHMLHLIMALAL