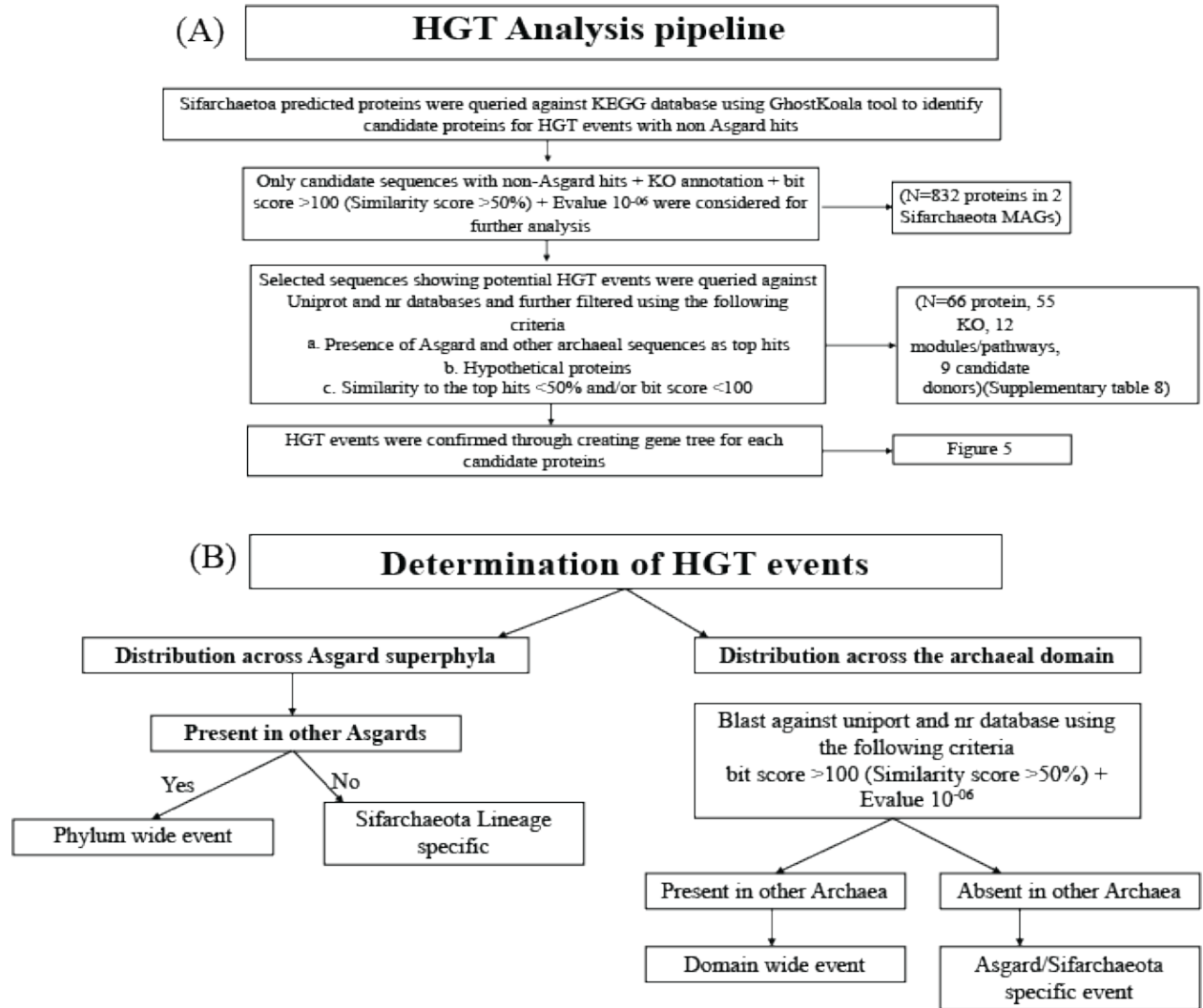


Supplemental Figure 1: Relative densities (numbers per 1 Mb) of peptidases and CAZymes encoded by the different Asgard MAGs.



Supplementary Figure 2. Workflow diagram describes the steps followed to identify HGT events in Sifarchaeota MAGs.

The following trees are visualized in Figure 5 of the main manuscript. We provide these files for others to evaluate the data on their own. Due to supplemental file type requirements, these data are not provided in a standard format.

>Supplementary tree 1\_ARSC\_HGT

(KPK62542\_1\_hypothetical\_protein\_AMJ83\_10530\_candidate\_division\_WOR\_3\_bacterium\_SM23\_42:0.6883476032,((((((((((((((HMM73760\_1\_arsenate\_reductase\_ArsC\_Armatimonadetes\_bacterium:0.5215106116,(VVB90874\_1\_Protein\_ArsC\_uncultured\_archaeon:0.0686560991,(WP\_097300620\_1\_arsenate\_reductase\_ArsC\_Candidatus\_Methanoperedens\_sp\_\_BL22:0.0467632148,VVB52417\_1\_Protein\_ArsC\_uncultured\_archaeon:0.0619802600)/0.978/93:0.0632425790)/1/100:0.3795295636)/1/85:0.1744631174,(GBD39594\_1\_Glutaredoxin\_arsenate\_reductase\_bacterium\_HR37:0.0371756289,HEE45704\_1\_arsenate\_reductase\_ArsC\_Candidatus\_Dadabacter

ia\_bacterium:0.0741878474)/1/100:0.5687504062)/0.619/15:0.0655277365,(((AGK61940\_1\_protein\_tyrosine\_phosphatase\_Archaeoglobus\_sulfaticallidus\_PM70-1:0.0000023071,WP\_144060627\_1\_arsenate\_reductase\_ArsC\_Archaeoglobus\_sulfaticallidus:0.0000026090)/1/100:0.3438770824,WP\_089322863\_1\_arsenate\_reductase\_ArsC\_Desulfurobacterium\_atlanticum:0.3277786338)/0.841/49:0.1439624035,(HEK12798\_1\_arsenate\_reductase\_ArsC\_Firmicutes\_bacterium:0.0918459695,HHV81168\_1\_arsenate\_reductase\_ArsC\_bacterium:0.4097082984)/1/98:0.1958182604)/0.955/46:0.0840257954)/0.877/18:0.0571058582,((((NC027882\_1\_arsenate\_reductase\_ArsC\_Caldiserica\_bacterium:0.3227862770,WP\_014453204\_1\_arsenate\_reductase\_ArsC\_Caldisericum\_exile:0.2846033994)/1/97:0.2248958087,(HGB36497\_1\_arsenate\_reductase\_ArsC\_candidate\_division\_WOR-3\_bacterium:0.1506166647,(HGL17194\_1\_arsenate\_reductase\_ArsC\_candidate\_division\_WOR-3\_bacterium:0.0043361890,HEN27581\_1\_arsenate\_reductase\_ArsC\_candidate\_division\_WOR-3\_bacterium:0.0155194265)/0.92/97:0.0438396188)/1/100:0.2206997977)/1/94:0.2018140403,(HHG31710\_1\_arsenate\_reductase\_ArsC\_Candidatus\_Bathyarchaeota\_archaeon:0.0775001406,HGV82126\_1\_arsenate\_reductase\_ArsC\_Candidatus\_Bathyarchaeota\_archaeon:0.0491070341)/1/100:0.3446997724)/0.949/78:0.0653305776,OHB89469\_1\_hypothetical\_protein\_A3D13\_04530\_Planctomycetes\_bacterium\_RIFCSPHIGHO2\_02\_FULL\_40\_12:0.4135381382)/0.713/46:0.0315643456,(HGE41023\_1\_arsenate\_reductase\_ArsC\_Candidatus\_Bathyarchaeota\_archaeon:0.3984790250,HID57387\_1\_arsenate\_reductase\_ArsC\_Candidatus\_Poribacteria\_bacterium:0.4602127824)/0.988/56:0.1378209077)/0.335/16:0.0033942439)/0.967/10:0.0258863606,(((EKQ53689\_1\_protein-tyrosine-phosphatase\_Methanobacterium\_sp\_\_Maddingley\_MBC34:0.2957387919,HII84670\_1\_arsenate\_reductase\_ArsC\_Methanobacterium\_subterraneum:0.2681505830)/1/100:0.3586916887,(HHD32168\_1\_arsenate\_reductase\_ArsC\_Elusimicrobia\_bacterium:0.5299854819,(WP\_051962905\_1\_arsenate\_reductase\_ArsC\_Mesoaciditoga\_lauensis:0.1969563479,WP\_170288391\_1\_arsenate\_reductase\_ArsC\_Athalassotoga\_saccharophila:0.2394146168)/1/100:0.2546071047)/0.553/72:0.0348903307)/0.385/51:0.0095034242,((((RLB23930\_1\_arsenate\_reductase\_ArsC\_Deltaproteobacteria\_bacterium:0.0000026090,RLB13927\_1\_arsenate\_reductase\_ArsC\_Deltaproteobacteria\_bacterium:0.0167828953)/1/100:0.3994751689,RLB21206\_1\_arsenate\_reductase\_ArsC\_Deltaproteobacteria\_bacterium:0.4119684034)/0.984/90:0.1102591154,KPK30277\_1\_hypothetical\_protein\_AMK69\_03890\_Nitrospira\_bacterium\_SG8\_3:0.3805210912)/0.967/76:0.1277149617,(PMQ01019\_1\_low\_molecular\_weight\_phosphatase\_family\_protein\_Dictyoglomus\_sp\_\_NZ13-RE01:0.4375822238,(WP\_148807201\_1\_arsenate\_reductase\_ArsC\_Dictyoglomus\_sp\_\_ob1-4:0.1969094564,(WP\_012582904\_1\_arsenate\_reductase\_ArsC\_Dictyoglomus\_turgidum:0.0404254731,WP\_012547737\_1\_arsenate\_reductase\_ArsC\_Dictyoglomus\_thermophilum:0.0782769039)/0.626/74:0.0268078054)/1/99:0.1598997148)/0.989/78:0.0873309551)/0.924/71:0.0837055463,(KUK27081\_1\_Arsenate\_reductase\_Acetothermia\_bacterium\_64\_32:0.2163525771,HGE04479\_1\_arsenate\_reductase\_ArsC\_Hadesarchaea\_archaeon:0.3348946858)/1/72:0.1295879165)/0.892/43:0.0331409268,(HGR05741\_1\_arsenate\_reductase\_ArsC\_Synergistetes\_bacterium:0.4063618836,KUK13738\_1\_Arsenate\_reductase\_bacterium\_42\_11:0.3368598429)/0.974/58:0.1160406325)/1/62:0.1322638821)/0.969/37:0.0362872747,HGM97662\_1\_arsenate\_reductase\_ArsC\_candidate\_division\_WOR-3\_bacterium:0.4810189623)/0.943/19:0.0221041877)/0.514/9:0.0216030184,(MQY57816\_1\_a

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2:0.0000025359,KRT63461\_1\_arsenate\_reductase\_\_arsenate\_reductase\_Candidatus\_Dadabact  
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minicenantes\_bacterium:0.2402574212)/0.997/86:0.1719835457)/0.989/56:0.0809701549,(OH  
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02\_FULL\_38\_41:0.4338407919,HGD17745\_1\_arsenate\_reductase\_ArsC\_Candidatus\_Bathyarch  
aeota\_archaeon:0.4304794181)/0.858/77:0.0969827530)/0.812/38:0.0339882760)/0.333/9:0.  
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atus\_Dadabacteria\_bacterium\_RIFCSPHIGHO2\_12\_FULL\_53\_21:0.4775039693,(TDI91151\_1\_ar  
senate\_reductase\_ArsC\_Candidatus\_Dadabacteria\_bacterium:0.2624805772,TFG77090\_1\_arse  
nate\_reductase\_ArsC\_Thermodesulfobacterales\_bacterium:0.2344623350)/1/98:0.203217150  
9)/1/99:0.2964313116,((OGD54358\_1\_ArsC\_family\_transcriptional\_regulator\_Candidatus\_Bath  
yarchaeota\_archaeon\_RBG\_13\_38\_9:0.5020864277,NCN64584\_1\_arsenate\_reductase\_ArsC\_C  
andidatus\_Altiarchaeum\_hamiconexum:0.2584636472)/0.992/90:0.1557366652,OQX18571\_1\_  
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Supplementary Tree 2: K0004\_HGT

(RMF93212\_1\_112-349\_2\_3-  
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633,WP\_172882550\_1\_120-357\_alcohol\_dehydrogenase\_catalytic\_domain-  
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\_114-351\_2\_3-  
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### Supplementary Tree 3: K01692\_HGT

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acterium:0.0771264191,HGH14475\_1\_1\_262\_enoyl\_CoA\_hydratase\_Candidatus\_Rokubacteria\_bacterium:0.0790330793)/0.953/85:0.0210386494)/0.458/25:0.0090677250,((OLB09379\_1\_1\_262\_enoyl\_CoA\_hydratase\_Candidatus\_Rokubacteria\_bacterium\_13\_2\_20CM\_69\_10:0.0357563034,PYN98811\_1\_1\_262\_enoyl\_CoA\_hydratase\_Candidatus\_Rokubacteria\_bacterium:0.0463099144)/1/100:0.0683310293,OLC15008\_1\_1\_262\_enoyl\_CoA\_hydratase\_Candidatus\_Rokubacteria\_bacterium\_13\_1\_40CM\_69\_27:0.0784271305)/0.999/87:0.0260793632)/0.995/68:0.0196295075,(((OLB07792\_1\_1\_262\_enoyl\_CoA\_hydratase\_Candidatus\_Rokubacteria\_bacterium\_13\_2\_20CM\_69\_15\_1:0.0830014062,(OLD26694\_1\_1\_262\_enoyl\_CoA\_hydratase\_Candidatus\_Rokubacteria\_bacterium\_13\_1\_40CM\_2\_70\_45:0.0040275936,(PYM50798\_1\_1\_262\_enoyl\_CoA\_hydratase\_Candidatus\_Rokubacteria\_bacterium:0.0039772065,OLC53983\_1\_1\_262\_enoyl\_CoA\_hydratase\_Candidatus\_Rokubacteria\_bacterium\_13\_1\_40CM\_4\_69\_39:0.0000011419)/0.333/71:0.0000030253)/0.965/100:0.0082024567)/1/56:0.0242732052,PYM41228\_1\_1\_262\_enoyl\_CoA\_hydratase\_Candidatus\_Rokubacteria\_bacterium:0.0101100552)/0.775/36:0.0096152218,(OLD69372\_1\_1\_262\_enoyl\_CoA\_hydratase\_Candidatus\_Rokubacteria\_bacterium\_13\_1\_20CM\_70\_15:0.0000025219,OLA95737\_1\_1\_262\_enoyl\_CoA\_hydratase\_Candidatus\_Rokubacteria\_bacterium\_13\_2\_20CM\_69\_15\_2:0.0288553087)/1/87:0.0313358716)/1/94:0.0531242451)/1/70:0.0402285480,PYM32998\_1\_1\_262\_enoyl\_CoA\_hydratase\_Candidatus\_Rokubacteria\_bacterium:0.0622140043)/0.633/36:0.0071882857,((PYM73548\_1\_3\_264\_enoyl\_CoA\_hydratase\_Candidatus\_Rokubacteria\_bacterium:0.0587534983,(((PYN01599\_1\_1\_262\_enoyl\_CoA\_hydratase\_Candidatus\_Rokubacteria\_bacterium:0.0245229547,PYM94085\_1\_1\_262\_enoyl\_CoA\_hydratase\_Candidatus\_Rokubacteria\_bacterium:0.0164117193)/1/100:0.0475472745,PYO03971\_1\_1\_262\_enoyl\_CoA\_hydratase\_Candidatus\_Rokubacteria\_bacterium:0.0127357115)/0.622/36:0.0042578622,PYN43555\_1\_1\_262\_enoyl\_CoA\_hydratase\_Candidatus\_Rokubacteria\_bacterium:0.0239953974)/0.859/42:0.0046695102,(PYN84318\_1\_1\_262\_enoyl\_CoA\_hydratase\_Candidatus\_Rokubacteria\_bacterium:0.0121369492,PYN30494\_1\_1\_262\_enoyl\_CoA\_hydratase\_Candidatus\_Rokubacteria\_bacterium:0.0167854425)/1/95:0.0283255945)/0.99/81:0.0189190200)/1/100:0.0509215449,(((OGL14337\_1\_1\_262\_enoyl\_CoA\_hydratase\_Candidatus\_Rokubacteria\_bacterium\_RIFCSPLOWO2\_12\_FULL\_71\_22:0.0082359667,OGL11301\_1\_1\_262\_enoyl\_CoA\_hydratase\_Candidatus\_Rokubacteria\_bacterium\_RIFCSPLOWO2\_02\_FULL\_72\_37:0.0000011419)/1/100:0.0603867093,OGK98302\_1\_1\_262\_enoyl\_CoA\_hydratase\_Candidatus\_Rokubacteria\_bacterium\_RIFCSPHIGHO2\_02\_FULL\_73\_26:0.0277197065)/0.719/63:0.0093490640,OGK85136\_1\_5\_265\_enoyl\_CoA\_hydratase\_Candidatus\_Rokubacteria\_bacterium\_GWA2\_73\_35:0.0293944764)/1/100:0.0597015982)/0.982/50:0.0144285657)/1/93:0.0347993947,(PYM32938\_1\_1\_262\_enoyl\_CoA\_hydratase\_Candidatus\_Rokubacteria\_bacterium:0.1474690414,PYM04251\_1\_1\_262\_enoyl\_CoA\_hydratase\_Candidatus\_Rokubacteria\_bacterium:0.0893598655)/1/89:0.0564249454)/1/97:0.0577196231)/1/100:0.1672003733)/1/96:0.1038125604)/0.91/60:0.0658240927)/1/95:0.1251190968)/0.86/48:0.0592687754)/0.886/33:0.0671080814,((RLB40763\_1\_4\_265\_enoyl\_CoA\_hydratase\_Deltaproteobacteria\_bacterium:0.2542390776,NQU12792\_1\_4\_263\_enoyl\_CoA\_hydratase/isomerase\_family\_protein\_Desulfobacteraceae\_bacterium:0.1757668497)/1/100:0.4102489937,(KPK47696\_1\_1\_263\_hypothetical\_protein\_AMJ77\_02300\_Dehalococcoidia\_bacterium\_SM23\_28\_2:0.2316131645,KPK21689\_1\_1\_263\_hypothetical\_protein\_AMJ76\_02015\_Dehalococcoidia\_bacterium\_SM23\_28\_1:0.2552745520)/1/100:0.2636743306)/0.981/57:0.0864397658)/0.857/29:0.0540162306,((MBD87052\_1\_3\_261\_enoyl\_CoA\_hydratase\_Rhodospirillaceae\_bacterium:0.0662127768,(PPR17935\_1\_3\_262\_12\_epoxyphenylacetyl\_CoA\_isomerase\_

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oteobacteria\_bacterium\_46\_93\_T64:0.0803262062)/0.994/99:0.0793761955)/1/100:0.538944  
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