

## Ko Hess Ki'ina Hana

### 'Ōwehe Laulā:

Ma kēia hō'ike a ke kumu, e kaha palapala 'āina ana nā haumāna i ka hi'ona 'āina ( a i 'ole ka bathymetry, 'o ia ho'i ka hi'ona lalo kai) o kekahi kūkohu pahu kāma'a o ka papakū o ka moana e like me ka hana a Harry Hammond Hess i kaha palapala 'āina i ka papakū o ka moana Pākīpika i ka manawa āna i ho'omōhala i ka mana'oha'i o ka pāhola 'ana o ka papakū. Ma kēia ha'awina haumana, e ho'ohana ana nā haumāna i ka 'ike o ke kuhikuhina kūpina'i e kūkulu i kekahi palapala 'āina o ka papakū.

### Nā Pahuhopu:

E a'o ana ka haumana:

- pehea e ho'ohana ai i kekahi lula e ana i ka bathymetry o kekahi kūkohu huna;
- e kākuhi i nā 'ikepili i loa'a;
- e ho'omaopopo i kā Harry Hammond Hess i kaha palapala 'āina ai i ka papakū o ka moana Pākīpika, 'o ia wahi nō kahi āna i huli a loa'a nā kualapa waena moana a me nā 'auwaha moana hohonu;
- e kūlulu i kekahi palapala 'āina o ka papakū me ka hana 'ana i ka 'ike o ke kuhikuhina kūpina'i; a me
- e hō'oa i ke kiko ma ka palapala 'āina, 'o ia ka 'auwaha moana.



#### Pili I Ka Hawai'i

'O ka 'ōpe'ape'a kekahi māmela 'āpa'akuma Hawai'i. Ho'ohana nā 'ōpe'ape'a, nā nai'a, a me nā koholā i echo location no ka ho'okele 'ana a me ka huli 'ana i mea'ai. Ho'ouna aku lākou i ke ki'ina leo ki'eki'e. Lele nā kani mai nā mea like 'ole mai. Ho'omohala ke kūpina'i a ho'i mai kēia kani i ka 'ōpe'ape'a. Maopopo ke kinona, ka nui, a me kahi o nā mea like 'ole me ka maika'i loa i nā 'ōpe'ape'a.

### Nā Pono Ha'awina:

- Ka pahu kāma'a me ka po'i
- Ka nūpepa
- Ka pahi
- Ka Māliki #1: "Ko Hess Ki'ina Hana Pakuhi"
- Nā Pepa Ha'awina Haumana: "Ko Hess Ki'ina Hana"
- Ke 'eke 'ea
- Plaster of Paris
- Ka lula

### Ke Ka'ina Hana Ha'awina:

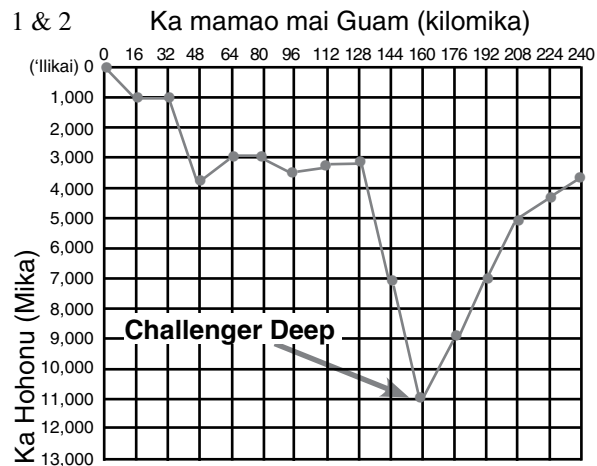
1. Aia ke ka'ina hana ha'awina ka hō'ike'ike koho na ke kumu ma ka hope o kēia ha'awina.
2. E wehewehe i nā haumāna, nā lākou e ho'okumu i kā lākou mau palapala 'āina o ka papakū e like me ka hana a Hess. E kāka'ahi i ka Pepa Ha'awina Haumana: "Ko Hess Ki'ina Hana." E heluhelu a kūkākūkā i Ka 'Ike Hou A'e. E heluhelu i ka mahele Pili I Ka Hawai'i.
3. E noi i nā haumāna e nānā i ka palapala 'āina ma ka 'ao'ao 'elua o nā pepa ha'awina haumana. E wehewehe o ka wahi hohonu i ka moana kahi kokoke i Guam. Kapa 'ia kēia wahi 'o Challenger Deep. Aia ia ma ka 'ao'ao hema o ka Mariana Trench. E noi i nā haumāna e wānana i ka mamao 'o Challenger Deep a me Guam. A laila e noi i nā haumāna e hāhai i nā kuhikuhi e ho'okō pono ai i nā pepa ha'awina haumana.
4. Ma hope o ka ho'okō 'ana o nā pepa ha'awina haumana e ha'i i nā hopena a laila 'ohi i nā pepa.

## Ko Hess Ki'ina Hana

Ka Pakuhi 'Ikepili Sonar:

Ka mamao mai Guam (km)	Ka huinanui manawa e ho'i ai ke kūpina'i i ka moku	Ka manawa o ke kani i hiki i ka papakū	Ka māmā kani i kai	Ka mamao i ka papakū i mika (Hohonu)
	Ka manawa huina i nā kekona	(Ka manawa huina ÷ 2)	1500 m/k	(Ka manawa huina ÷ 2) x 1500 m/k = Ka mamao
0	0	0	1500	0
16	1.34	.67	1500	1005
32	1.34	.67	1500	1005
48	5.22	2.61	1500	3915
64	4.00	2.00	1500	3000
80	4.00	2.00	1500	3000
96	4.88	2.44	1500	3660
112	4.27	2.14	1500	3210
128	4.13	2.07	1500	3105
144	9.47	4.74	1500	7110
160	14.70	7.35	1500	11025
176	12.00	6.00	1500	9000
192	9.33	4.67	1500	7005
208	6.80	3.40	1500	5100
224	5.60	2.80	1500	4200
240	5.07	2.54	1500	3810

Ka 'Ikepili Kālailai:



Ka Hopena:

Inā pololei ka 'ikepili sonar i 'ohi 'ia 160 km ka mamao mai Guam.

Nā Pane I Nā Nīnau Hou A'e:

1. c) Harry Hammond Hess

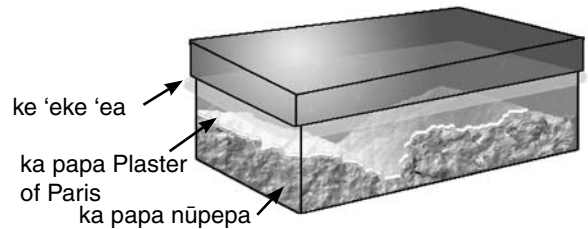
Nā Pane I Ka No'ono'o Loi:

1. E 'oko'a ana nā pane
2. E 'oko'a ana nā pane

## Ko Hess Ki'ina Hana

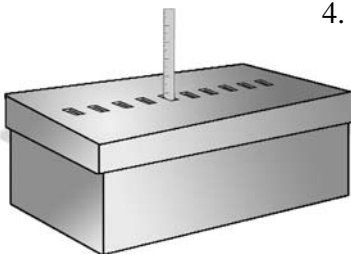
### Ke Ka'ina Hana Na Ke Kumu:

1. Ma mua o ke Kaua Honua 'Elua, 'a'ole nui nā 'ike e pili ana i ka papakū. I ka manawa o ke kaua i ho'okumu 'ia ai ka sonar no ia kumu i hiki ke hana 'ia nā palapala 'āina lāli'i o ka papakū. 'O Harry Hammond Hess kekahi kanaka hulihonua mai ke kulanui 'o Princeton. 'O ia ke kapena o kekahi ka'a halihali 'ohua 'o *Cape Johnson*. I kona noho 'ana i ka moana Pākīpika i ka manawa o ke Kaua Honua 'Elua, ua ho'ohana 'o Hess i ke kuhikuhi kūpina'i (sonar) o kona moku e 'ohi i ka 'ikepili o ka papakū. Ma hope mai, ua ho'ohana 'o ia i kēia 'ike e kūkulu i kekahi palapala 'āina o ka papakū a laila ua mōhala ke kuhiakau o ka pāhola 'ana o ka papakū.



2. No ka ho'omākaukau 'ana o kēia ha'awina, e hana i kekahi kūkohu pahu kāma'a o kekahi 'auwaha moana. E ho'opōpō ka nūpepa a waiho ma ka lalo o ka pahu kāma'a. E ho'ohui ka Plaster of Paris ma luna o ka nūpepa, o ka hopena he kūkohu o ka hi'onaina. E hō'oia i kekahi 'auwaha moakaka. E waiho ka Plaster of Paris a malo'o a pa'akikī. I kāu kūkohu e malo'o ana e pahu ka pahi ma luna o ke po'i, me ka 'oki'oki 'ana i nā 'oā he 'elua kenimika kona nui. 'O ka nui o ka 'oā he nui i hiki ke komo kekahi lula i loko. Ke hele a malo'o ke kūkohu e kau ke po'i ma luna o ka pahu kāma'a. Mai 'ae i nā haumāna e nānā i loko o ka pahu kāma'a.

3. E wehewehe i nā haumāna, e kaha palapala 'āina ana nā haumāna i ka bathymetry i ke kūkohu o ka papakū o ka moana i loko o ka pahu kāma'a. E hana ana lākou i kekahi palapala 'āina e like me ka mea a Hess i kaha palapala 'āina ai o ka papakū. Ma kēia ha'awina, 'o ka 'ilikai ke po'i o ka pahu kāma'a a 'o ke kūkohu i loko o ka pahu kāma'a ka papakū. Ua ho'ohana 'o Hess i nā mauha'a nāna e ho'opapā ka mamao i ka papakū o ka moana mai ka 'ilikai (kona moku). Ho'ouna kēia mau mauha'a i ka wawā kani i loko o ke kai i mea e hiki ke ho'opalapala 'ia nā ana. Ho'ohana ka po'e he nui i nā mauha'a ma luna o nā moku e ho'opapā ka hohonu o ke kai a i 'ole e huli a loa'a ka i'a. E ha'i i nā haumāna, e ho'ohana ana lākou i ka lula no ka ho'omōhala 'ana i kā lākou mau palapala 'āina.

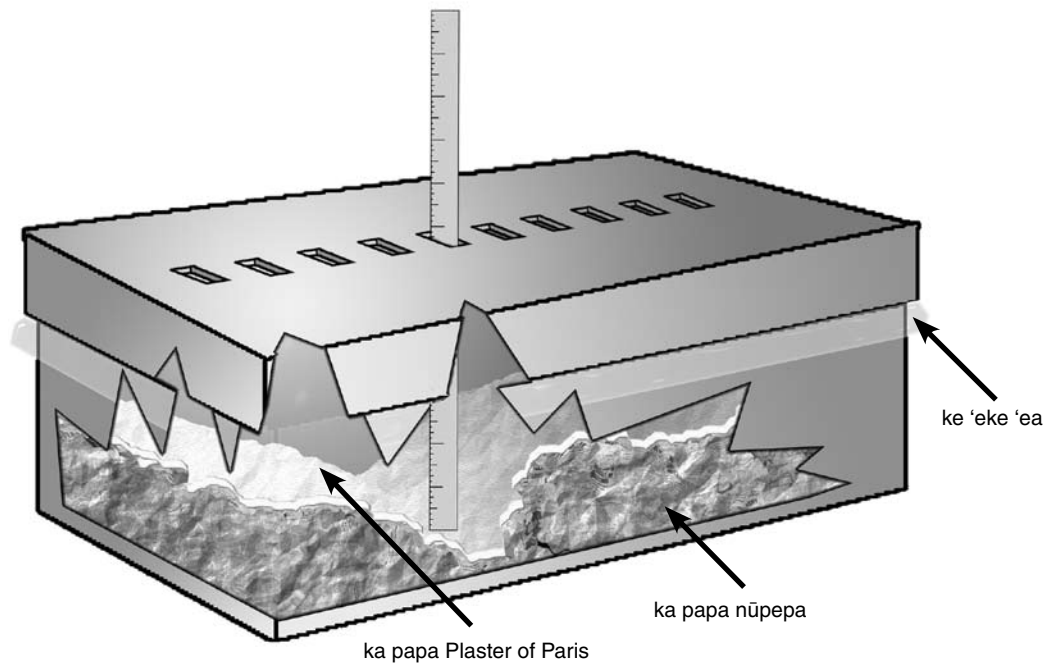


4. E wehewehe ho'i e ho'opapā ana lākou ka mamao o ka 'ilikai a hiki i ka papakū mai nā puka pākahi ma ke po'i o ka pahu kāma'a. E hō'ike kēia i ka ho'okomo 'ana i ka lula ma ka puka mua. E heluhelu i ka huahelu (helu kenimika) ma luna o ka lula ma ke po'i. E wehewehe ho'i o kēia huahelu ka mamao o ka 'ilikai a i ka papakū. Ma kēia ha'awina, ua like ho'okahi kenimika me ho'okahi kaukani mika. 1 kenimika (knm)=1,000 mika (m). E noi i kekahi haumana e ana i kēlā me kēia kenimika 'elua (2,000 m) ma ke po'i. E noi i kekahi haumana e palapala ka 'ike.

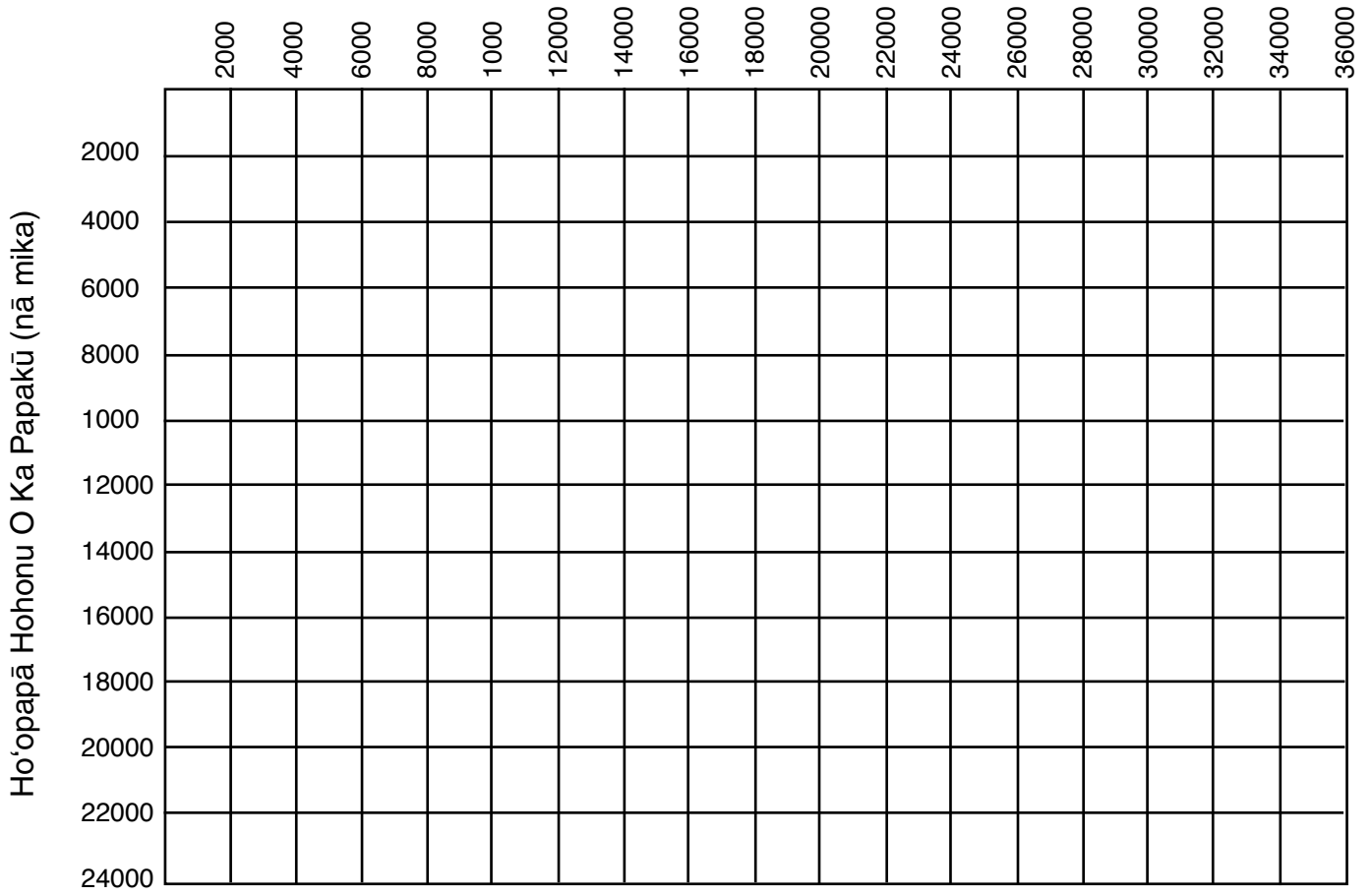
## Ko Hess Ki'ina Hana

### *Ke Ka'ina Hana Na Ke Kumu:*

5. E kau ka Māliko #1: “Ko Hess Ki'ina Hana Pakuhi” ma luna o ka mīkini ki'iaka. E noi i ho'okahi haumana e ho'ohana i ka peni māka e kākuhi i nā mamao ma luna o ka māliko, me ke kaha 'ana i ka hohonu ma ka iho “y” a no ke ana papamoe, e kaha ma ka iho “x.”
6. I ke kākuhi 'ana o nā ana, e helu pono ma nā mika ka heluna kiko'i mai luna (Nā mika 1,000) a i lalo ka hohonu pākahi, a e kau ke kiko no ke kuhikuhina o nā papamoe a pau. Kuhikuhi ka luna o ka pakuhi i ka 'ilikai, a o ka pakuhi he hō'ike i ka mamao o ka 'ilikai a i ka papakū o ka moana. E noi i ka haumana e ho'ohui i nā kiko huina ma ka pakuhi.
7. E kūkākūkā i nā hopena o nā haumāna a laila e hō'ike i ke kūkohu o ka papakū ma ka wehe 'ana i ke po'i o ka pahu kāma'a. E like ana ke kinona o ke kūkohu me ke kaha uli ma ka māliko. E noi i nā haumāna inā hiki iā lākou ke kuhikuhi kahi pāpa'u ma ka pakuhi. Inā 'o kēia kekahi palapala 'āina o ka papakū, he kuhikuhi kēlā wahi i kekahi kualapa waena moana. E noi i nā haumāna e kuhikuhi i ka wahi hohonu ma ka pakuhi. Inā 'o kēia kekahi palapala 'āina o ka papakū, kuhikuhi kēlā wahi i kekahi 'auwaha moana.



Ka Mamao Ma Kēlā 'Ao'ao O Ka 'Ilikai (nā mika)



## Ko Hess Ki‘ina Hana

***Ka Nīnau Ho‘ā‘o:***

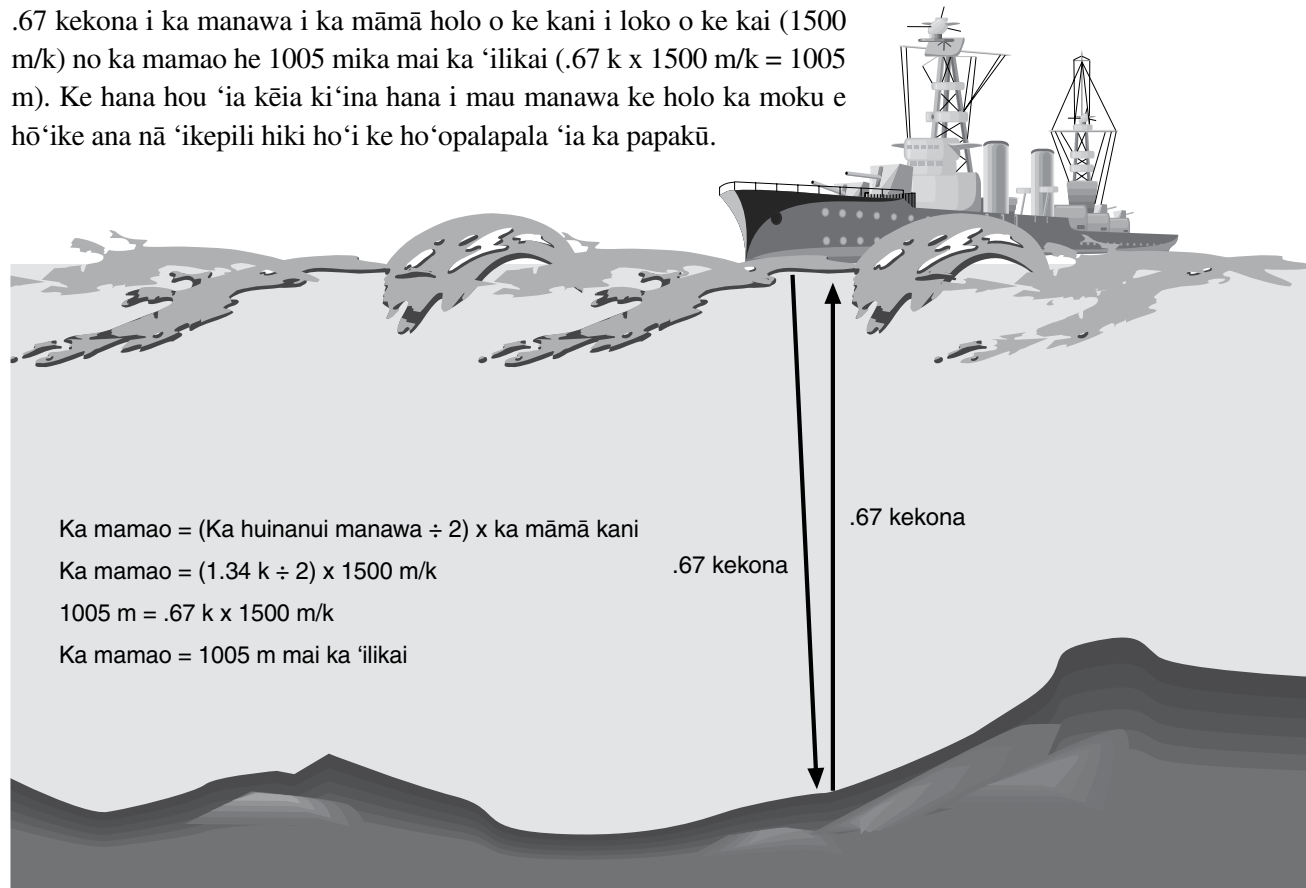
He aha ka mamao o Challenger Deep maiā Guam (ke kiko hohonu loa i ka moana)?

***Ka ‘Ike Hou A‘e:***

Ma mua o ke Kaua Honua ‘Elua, ‘a‘ole nui nā ‘ike e pili ana i ka papakū. I ka manawa o ke kaua i ho‘okumu ‘ia ai ka sonar a laila hiki ke hana i nā palapala ‘āina lāli‘i o ka papakū. ‘O Harry Hammond Hess kekahi kanaka hulihonua mai ke kulanui ‘o Princeton. Ua lilo ‘o ia i kapena o ka moku Cape Johnson. I kona noho ‘ana i ka moana Pākīpika, ua ho‘ohana ‘o Hess i ke kuhikuhina kūpina‘i (sonar) o kona moku e ‘ohi i ka ‘ikepili o ka papakū. Ma hope aku, ua ho‘ohana ‘o ia i kēia ‘ike e kūkulu i kekahi palapala ‘āina o ka papakū a laila ua ho‘omōhala ‘o ia ke kuhiakau o ka pāhola ‘ana o ka papakū.

Hana ke kuhikuhina kūpina‘i ma ka ho‘ouna aku i ke kani, kapa ‘ia kēia ka ping mai ka moku mai. Lele aku kēlā kani mai ka papakū a ho‘i hou i ka moku. I ka helu ‘ana o ke kani, hiki i nā kānaka ‘epekema ke ho‘oholo i ka ho‘opapā hohonu o ka papakū. No ka ho‘oholo ‘ana o ka ho‘opapā hohonu o ka papakū, pono e ‘ike ‘ia ka manawa o ke kūpina‘i a me ka māmā o ke kani i loko o ke kai. Ma kahi o 1500 m/k (nā mika i ho‘okahi kekona) ka māmā kani i ke kai.

Eia kekahi la‘ana, inā ho‘ouna ka moku kekahi ping a kūpī kēia kani i loko o 1.34 kekona, ua holo ia kani i lalo i ke kai i loko o .67 kekona a kūpī ho‘i mai i loko o .67 kekona ( $1.34 \text{ k} \div 2 = .67 \text{ kekona}$ ). A laila e ho‘onui ka .67 kekona i ka manawa i ka māmā holo o ke kani i loko o ke kai ( $1500 \text{ m/k}$ ) no ka mamao he 1005 mika mai ka ‘ilikai ( $.67 \text{ k} \times 1500 \text{ m/k} = 1005 \text{ m}$ ). Ke hana hou ‘ia kēia ki‘ina hana i mau manawa ke holo ka moku e hō‘ike ana nā ‘ikepili hiki ho‘i ke ho‘opalapala ‘ia ka papakū.



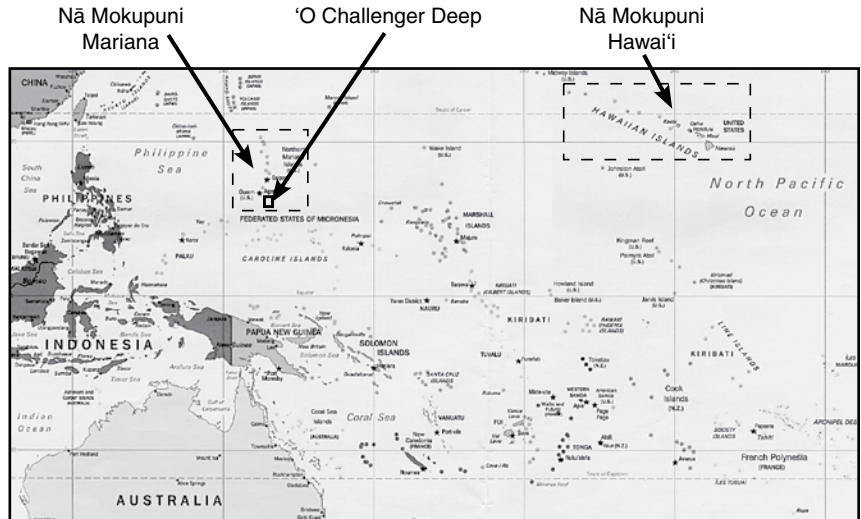
## Ko Hess Ki‘ina Hana

**Ke Kuhiakau:**

Inā pololei ka ‘ikepili sonar, \_\_\_\_\_ km ka mamao maiā Guam i ka Challenger Deep.

**Ka ‘Ikepili:**

Eia na‘e nā ho‘opa‘a ‘ikepili sonar ma lalo nei mai ka papakū kokoke i Guam kahi o Challenger Deep. E kōkua ana ka ‘ikepili sonar e ho‘okumu i kekahi palapala ‘āina o ka papakū o ka moana. E ho‘omaka i ka ho‘opihia ‘ana o ka Pakuhi ‘Ikepili Sonar. Ua hana ‘ia ka ho‘omaulia mua. E kolikoli i nā kekimala (decimals) i ka hapa haneli.



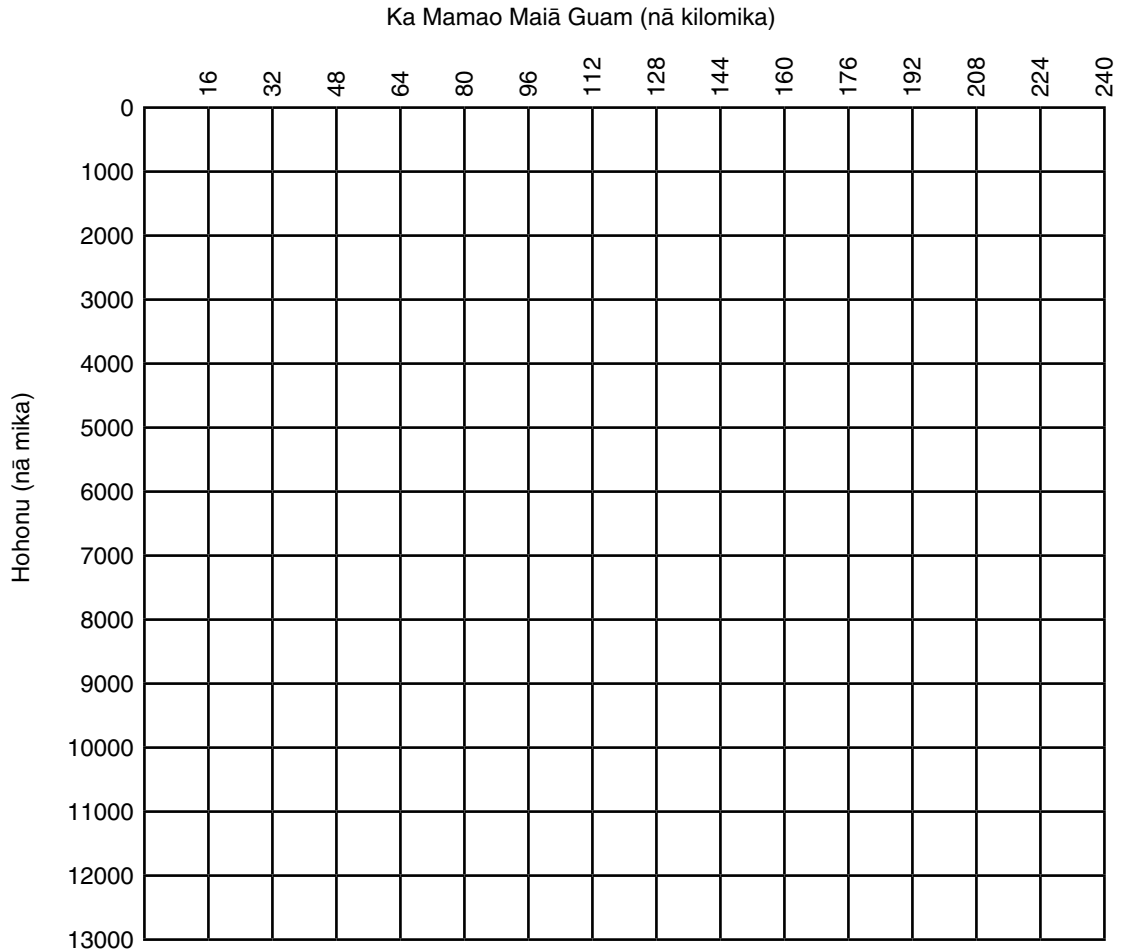
**Pakuhi ‘Ikepili Sonar**

Ka Mamao Mai Guam (km)	Ka Huinanui Manawa E Ho‘i Ai Ke Kūpina‘i I Ka Moku <small>ka huinanui manawa kekona</small>	Ka Manawa O Ke Kani I Hiki I Ka Papakū <small>(ka huinanui manawa / 2)</small>	Ka Māmā Kani I Kai <small>(1500 m/k)</small>	Ho‘opapā Hohonu I Mika (hohonu) <small>(ka huinanui manawa/2) x 1500 m/k= mamao</small>
0	0	0	1500	0
16	1.34	.67	1500	1005
32	1.34		1500	
48	5.22		1500	
64	4.00		1500	
80	4.00		1500	
96	4.88		1500	
112	4.27		1500	
128	4.13		1500	
144	9.47		1500	
160	14.70		1500	
176	12.00		1500	
192	9.33		1500	
208	6.80		1500	
224	5.60		1500	
240	5.07		1500	

## Ko Hess Ki'ina Hana

***Ka 'Ikepili Kālailai:***

1. E kākui i nā 'ikepili mai ka Pakuhi 'Ikepili Sonar ma lalo nei.



2. Ma ka pakuhi, e kākui i ka hua'ōlelo "Challenger Deep" ma kahi hohonu loa o ka 'auwaha moana.

***Ka Hopena:***

Inā pololei ka 'ikepili sonar, \_\_\_\_\_ km ka mamao maiā Guam i ka Challenger Deep.

Pehea kou kuhiakau ua hō'ōia a i 'ole hō'ōia 'ole? E kākui i kekahi hopuna 'ōlelo piha.

---



---

**Ko Hess Ki'ina Hana**

***Nā Nīnau Hou 'Ē A'e:***

1. 'O wai ka mea e ho'omohala i ka mana'oha'i o ka pāhola 'ana i ka papakū?
  - a) J. Tuzo Wilson
  - b) Pierre Laplace
  - c) Harry Hammond Hess
  - d) Florence Bascon

***Ka No'ono'o Loi:***

1. He aha ka pilina o ka manawa no ka ho'i mai o ka sonar ping i ka moku a me ka hohonu o ka moana?

---

---

---

---

2. Pehea nā mea like a me nā mea 'oko'a o ka lula a me ka pahu kāma'a i kaha palapala 'āina mai ko Hess ki'ina hana o ka papaku o ka moana? E ho'opiha i ke ki'ikuhi ma lalo nei.

