

Norhopanes

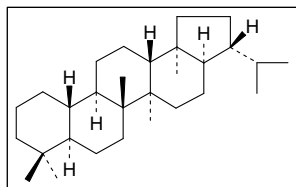
Pentacyclic triterpanes of the hopane type are ubiquitous constituents of sedimentary organic matter. Crude oils and mature sediments usually contain a predominance of hopanes with $17\alpha(\text{H}),21\beta(\text{H})$ -skeletal configurations.¹ However, a number of rearranged (Biomarker Focus 35) and demethylated hopanes are present in diagnostic quantities for geochemical and oil spill (environmental forensics) applications.

A related, but less common, group of hopanes with n-alkane side chain (the 30-nor series) is also widely distributed.^{2,3,4}



25-Norhopanes

The 25-norhopanes is a series of C_{26} - C_{34} compounds that are related to the normal hopanes. Their origin is a topic of dispute, microbial production or microbial demethylation. 25-Norhopane elutes between $\alpha\beta$ - $\beta\alpha$ Bishnorhopanes (Cat. No. **2637.28** and Cat. No. **2636.28**) and $29\alpha\beta$ (Cat. No. **1321.29**).

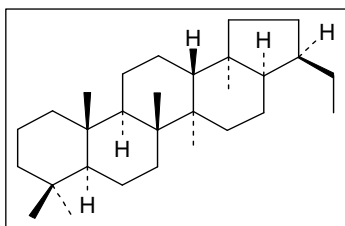


Cat.No. **2638.29**
 $17\alpha(\text{H}),21\beta(\text{H})$ -25-Norhopane (25Nor)

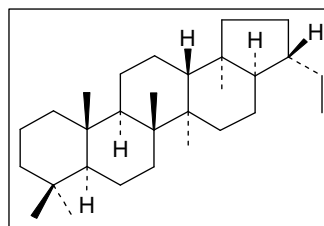
30-Norhopanes

The 30-norhopanes is a series of hopanes with one less methyl group in the sidechain than the hopanes. They are widely distributed in sediments and oils. The dominant member in mature sediments is the $17\alpha(\text{H}),21\beta(\text{H})$ -30-norhopane ($29\alpha\beta$, Cat. No. **1321.29**), but the series ranges from C_{29} to C_{34} .^{2,3,4}

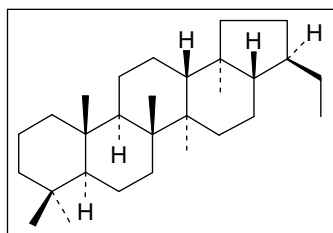
All four isomers of the C_{29} 30-norhopanes are available as standards from Chiron.



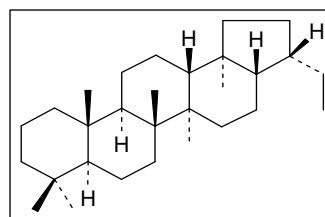
Cat.No. **1367.29**
 $17\alpha(\text{H}),21\alpha(\text{H})$ -30-Norhopane ($29\alpha\alpha$)



Cat.No. **1321.29**
 $17\alpha(\text{H}),21\beta(\text{H})$ -30-Norhopane ($29\alpha\beta$)



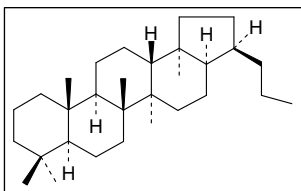
Cat.No. **0614.29**
 $17\beta(\text{H}),21\alpha(\text{H})$ -30-Norhopane ($29\beta\alpha$)



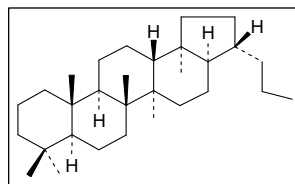
Cat.No. **2640.29**
 $17\beta(\text{H}),21\beta(\text{H})$ -30-Norhopane ($29\beta\beta$)

C₃₀ 30-Norhopanes

This group is the lowest of the normal normethylhomohopane series. Chiron offers the 29nor30 $\alpha\alpha$ and 29nor30 $\alpha\beta$ isomers. The $\alpha\beta$ -isomer elutes just after the most abundant C₃₀-hopane, the 17 α (H),21 β (H)-hopane (Cat. No. **0132.30**). The $\alpha\alpha$ -isomer elutes between 17 α (H),21 β (H)-hopane (30 $\alpha\beta$, Cat. No. **0132.30** and gammacerane (Cat. No. **2646.30**).^{1,3-5}



Cat.No. 2179.30
17 α (H),21 α (H)-30-Nor-29-methylhopane
 (29nor30 $\alpha\alpha$)

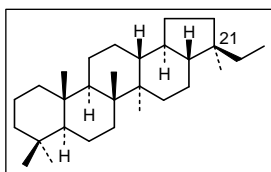


Cat.No. 2262.30
17 α (H),21 β (H)-30-Nor-29-methylhopane
 (29nor30 $\alpha\beta$)

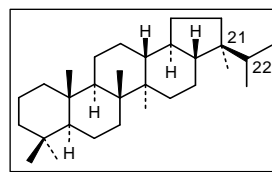
Rearranged norhopanes: Nor-spergulanes

A new series of rearranged hopanes ranging from C₂₉ to C₃₄ has recently been identified as 28-nor-spergulanes (or 21-methyl-28-nor-hopanes).

The C₂₉ member of the series was unambiguously identified as 17 β (H),18 α (H)-28-nor-spergulane (29Nsp, Cat. No. **2883.29**) by NMR-spectroscopy.⁶ 29Nsp elutes midway between C₃₀ 17 α -diahopane (30Dia or C₃₀^{*}, Cat. No. **2886.30**) and 17 β ,21 α -30-norhopane (29 $\alpha\beta$, Cat. No. **1321.29**). The C₂₉ 28-nor-spergulane (29Nsp) is always the dominant member of the series and can be detected in most crude oils or mature sediments using GC-MS. Their content is generally high in samples having high amounts of rearranged hopanes (diahopanes and neohopanes). 29Nsp seems to be particularly abundant in some oils from lacustrine source rocks in South East Asia.



Cat. No. 2883.29
17 β (H),18 α (H)-28-Nor-spergulane
 (29Nsp)

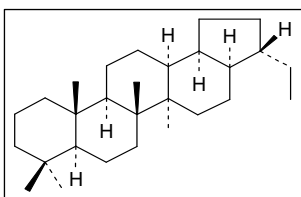


Cat. No. 2884.30
17 β (H),18 α (H)-22-Methyl-28-nor-spergulane
 (30Nsp)

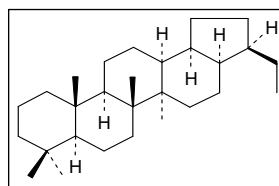
Bisnorhopanes

28,30-Bisnorhopanes (BNH)

Bisnorhopanes are diagnostic hopanes both in geochemical analysis and in oil spill analysis. The structure of 17 α (H),21 β (H)-28,30-bisnorhopane (Cat. No. **2637.28**) was established by Seifert et al. by X-ray crystallography after isolation from Monterey shale.⁷ This compound co-elutes with the 28 $\beta\alpha$ isomer (Cat. No. **2636.28**) under standard GC conditions and misidentification is possible since both isomers are present in petroleum. They are distinguished by liquid chromatography, as the 28 $\beta\alpha$ isomer is a lot more retained on certain C₁₈ HPLC columns. The 28 $\beta\beta$ -isomer is stable within the oil-generation window, and occurs in smaller amounts.



Cat.No. 2637.28
17 α (H),18 α (H),21 β (H)-28,30-Bisnorhopane
 (28 $\alpha\beta$ or BNH)



Cat. No. 2636.28
17 β (H),18 α (H),21 α (H)-28,30-Bisnorhopane
 (28 $\beta\alpha$ or BNH)

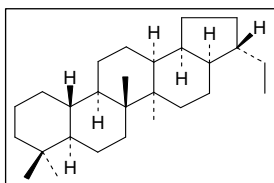


Trisnorhopanes

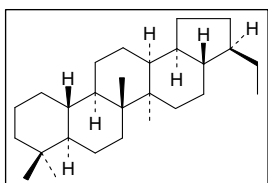
25,28,30-Trisnorhopanes (TNH)

TNH are formed by biodegradation from BNH. TNH isomers are diagnostic hopanes both in geochemical and oil spill analysis. Three isomers are present in petroleum, and all are available as identification standards from Chiron. As for the bisnorhopanes, 28 α β and the 28 β α are present in largest quantities. The 28 β β -isomer is stable within the oil-generation window, and occurs in smaller amounts.

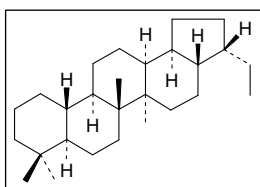
25nor28 α β (Cat. No. **2632.27**) and 25nor28 β α (Cat. No. **2634.27**) elutes between Ts (Cat. No. **2635.27**) and Tm (Cat. No. **0615.27**) while 25nor28 β β (Cat. No. **2633.27**) elutes just after Tm.



Cat.No. 2634.27
17 α (H),18 α (H),21 β (H)-25,28,30-Trisnorhopane
 (25nor28 α β (TNH))



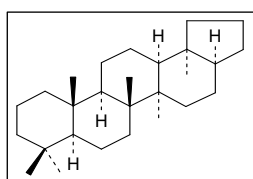
Cat.No. 2632.27
17 β (H),18 α (H),21 α (H)-25,28,30-Trisnorhopane
 (25nor28 β α (TNH))



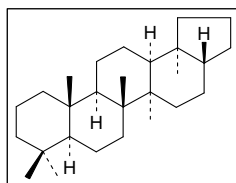
Cat.No. 2633.27
17 β (H),18 α (H),21 β (H)-25,28,30-Trisnorhopane
 (25nor28 β β)

22,29,30-Trisnorhopane (Tm)

Tm elutes after Ts and in front of 29Diahopane. 17 α (H)-22,29,30-Trisnorhopane (Tm) is more stable than 17 β (H)-22,29,30-Trisnorhopane (β Tm) and is the dominant of the two in more mature sediments. However, β Tm is relatively more stable than hopane (30 β β or 17 β (H),21 β (H)-hopane, **Cat. No. 0613.30**), but less stable than moretane (30 β α or 17 β (H),21 α (H)-hopane, **Cat. No. 0612.30**).



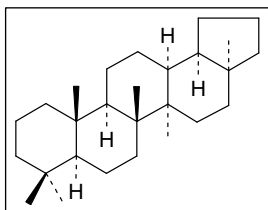
Cat.No. 0615.27
17 α (H)-22,29,30-Trisnorhopane (Tm)



Cat.No. 2639.27
17 β (H)-22,29,30-Trisnorhopane (β Tm)

22,29,30-Trisnorneohopane (Ts)

Ts/(Ts+Tm)⁵: 27Ts (Cat. No. **2635.27**) is more stable than the non-rearranged Tm (17 α (H)-22,29,30-trisnorneohopane, Cat. No. **0615.27**), and thus the ratio Ts/(Ts+Tm) (sometimes reported as Ts/Tm) is a much used maturity parameter. The ratio may also relate to the source as it is not clear whether the conversion Tm to Ts occur. The ratio should be used with caution, and reference standards are required. Tm and Ts commonly co-elute with tricyclic or tetracyclic terpanes on the *m/z* 191 mass chromatogram.



Cat.No. 2635.27
18 α (H)-22,29,30-Trisnorneohopane
 Ts (27Ts)

Oil Spill Identification / Environmental Forensics

Biomarkers play an important role in oil spill identification, and certain norhopanes are frequently used as diagnostic markers.⁸⁻¹¹ In articles on oil spill identification one often see that a different code is used for the hopane biomarkers as used in the geochemical literature.

Frequently used Diagnostic Oil Spill Ratios related to norhopanes:

	Code used here	Code used in ref. 11
18 α (H)-Trisnorhopane/17 α (H)-Trisnorhopane	Ts/Tm	Ts/Tm
28,30-Bisnorhopane (BNH)/C ₃₀ $\alpha\beta$ -hopane		(28 $\alpha\beta$ +28 $\beta\alpha$)/30 $\alpha\beta$ H28/H30
C ₂₉ $\alpha\beta$ 25-Norhopane/C ₃₀ $\alpha\beta$ -hopane	25nor/30 $\alpha\beta$	NOR25H/H30
C ₂₉ $\alpha\beta$ 30-Norhopane/C ₃₀ $\alpha\beta$ -hopane	29 $\alpha\beta$ /30 $\alpha\beta$	H29/H30

Standards available from Chiron

- 5 μ g quantities are supplied in convenient 300 μ L GC-vials for dilution to e.g. 50-100 μ g/mL
- Quantities are measured relative to the intensity (TIC) of the 30 $\alpha\beta$ hopane or by gravimetry
- The purity is generally 95%+, but in some instances (*) it is a mixture with other hopane biomarkers

2632.27	17 β (H),18 α (H),21 α (H)-25,28,30-Trisnorhopane (TNH)	25nor28 $\beta\alpha$	5 μ g
2634.27	17 α (H),18 α (H),21 β (H)-25,28,30-Trisnorhopane (TNH)	25nor28 $\alpha\beta$	5 μ g
2633.27	17 β (H),18 α (H),21 β (H)-25,28,30-Trisnorhopane	25nor28 $\beta\beta$	5 μ g
2635.27	18 α (H)-22,29,30-Trisnorhopane	Ts (27Ts)	5 μ g
0615.27	17 α (H)-22,29,30-Trisnorhopane	Tm	100 μ g/mL*
2639.27	17 β (H)-22,29,30-Trisnorhopane	β Tm	5 μ g
2637.28	17 α (H),18 α (H),21 β (H)-28,30-Bisnorhopane (BNH)	28 $\alpha\beta$	5 μ g
2636.28	17 β (H),18 α (H),21 α (H)-28,30-Bisnorhopane (BNH)	28 $\beta\alpha$	5 μ g
2638.29	17 α (H),21 β (H)-25-Norhopane	25Nor	5 μ g
0614.29	17 β (H),21 α (H)-30-Norhopane (Isoadiantane)	29 $\beta\alpha$	100 μ g/mL*
1321.29	17 α (H),21 β (H)-30-Norhopane	29 $\alpha\beta$	50 μ g/mL*
1367.29	17 α (H),21 α (H)-30-Norhopane	29 $\alpha\alpha$	50 μ g/mL*
2640.29	17 α (H),21 β (H)-30-Norhopane	29 $\beta\beta$	50 μ g/mL*
2883.29	17 β (H),18 α (H)-28-Nor-spergulane	29Nsp	5 μ g
2884.30	17 β (H),18 α (H)-22-Methyl-28-nor-spergulane	30Nsp	5 μ g
2179.30	17 α (H),21 α (H)-30-Nor-29-methylhopane	29nor30 $\alpha\alpha$	50 μ g/mL*
2262.30	17 α (H),21 β (H)-30-Nor-29-methylhopane	29nor30 $\alpha\beta$	50 μ g/mL*

* In iso-octane

Literature

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