Concise Total Syntheses of (−)-Crinipellins A and B Enabled by a Controlled Cargill Rearrangement

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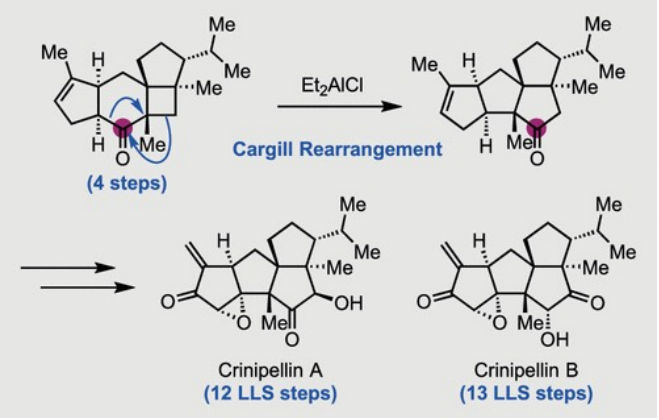
Cite This: J. Am. Chem. Soc. 2024, 146, 21250–21256

tetraquinane skeleton,

both a linear cis,anti,cis-triquinane (ABC rings) and an angular triquinane (BCD rings).

an intramolecular photochemical [2 +2] cycloaddition, a reliable method to generate adjacent allcarbon quaternary centers.



Scheme 2. Total Syntheses of (−)-Crinipellins A and B

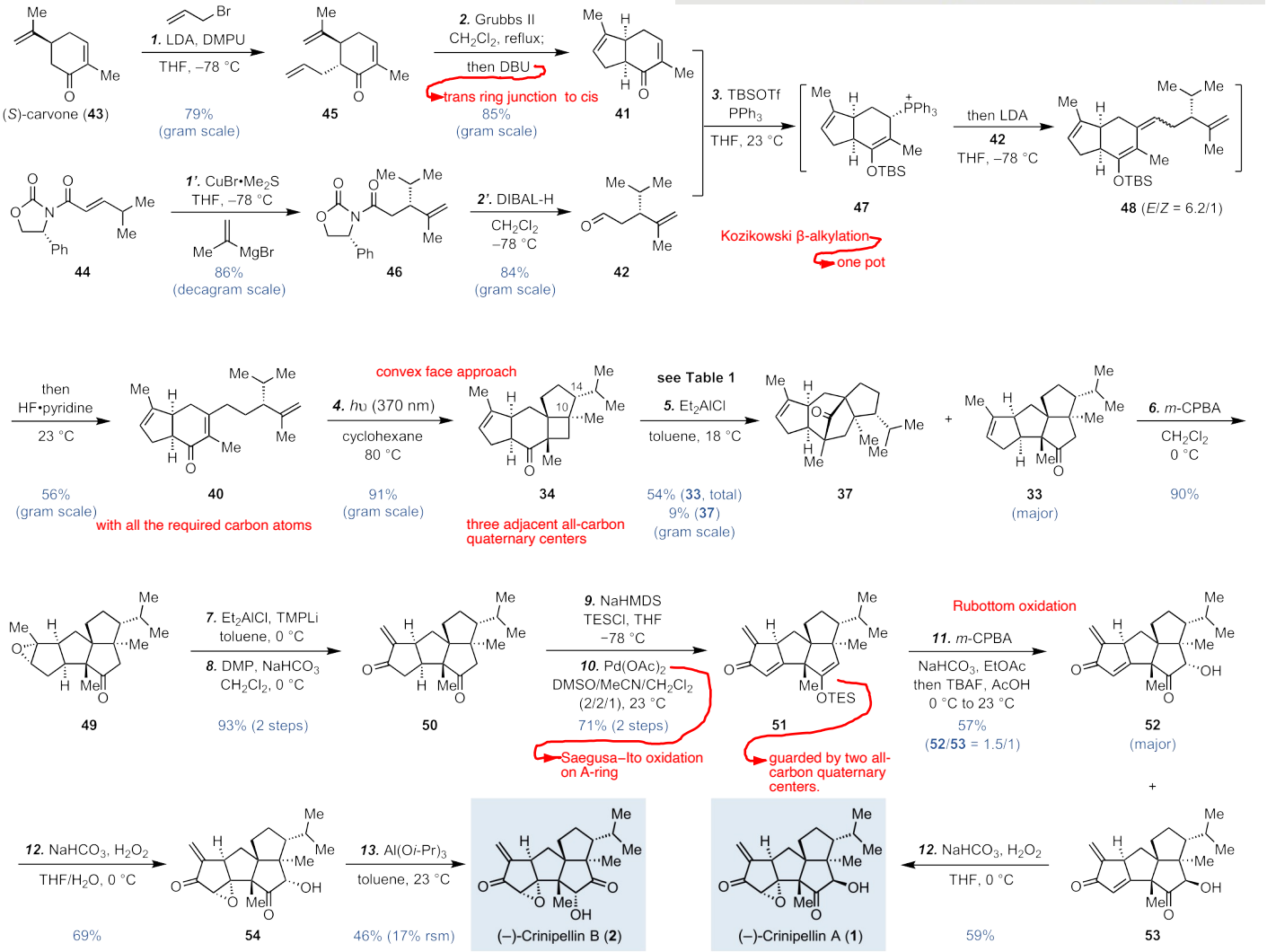
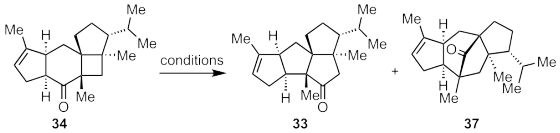
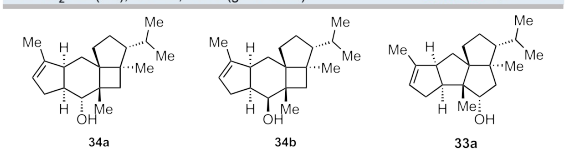


Table 1. Cargill Rearrangement Optimization



entry	reaction conditions (equiv)	results (33/37/34)
1	*p*-TsOH (1.0), PhH, 80 °C	18%/45%/0%[a]
2	*p*-TsOH (1.0), LiCl, toluene, 23 °C	0%/0%/85%[a]
3	Tf_2NH (1.0), CH_2Cl_2, 23 °C	9%/51%/0%[a]
4	$Mg(ClO_4)_2$ (1.0), CH_2Cl_2, 23 °C	0%/0%/91%[a]
5	$ZnCl_2$ (1.0), CH_2Cl_2, 23 °C	0%/79%/0%[a]
6	$ZnBr_2$ (1.0), CH_2Cl_2, 23 °C	0%/21%/69%[a]
7	$InCl_3$ (1.0), toluene, 23 °C	8%/82%/0%[a]
8	BF_3•Et_2O (1.0), CH_2Cl_2, 23 °C	7%/59%/0%[a]
9	$AlCl_3$ (1.0), CH_2Cl_2, 23 °C	5%/42%/0%[a]
10	Me_2AlCl (1.0), CH_2Cl_2, 23 °C	32%/45%/0%[a]
11	Me_2AlCl (1.0), LiCl, CH_2Cl_2, 23 °C	33%/40%/0%[a]
12	$EtAlCl_2$ (1.0), CH_2Cl_2, 23 °C	28%/46%/0%[a]
13	$EtAlCl_2$ (1.0), LiCl, CH_2Cl_2, 23 °C	32%/48%/0%[a]
14	Et_2AlCl (1.0), CH_2Cl_2, 23 °C	35%/23%/0%[a]
15	Et_2AlCl (1.0), LiCl, CH_2Cl_2, 23 °C	52%/25%/0%[a]
16	Et_2AlCl (1.0), toluene, 23 °C	65%/16%/0%[a]
17	Et_2AlCl (1.0), LiCl, toluene, 23 °C	59%/10%/0%[a]
18	Et_2AlCl (1.0), toluene, 18 °C (gram scale)	54%[b]/9%/0%[c]

less Lewis acidic



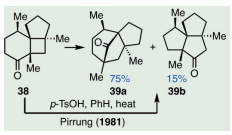
gram scale reaction byproducts

DMP oxidation

33

[a]Yield was determined by NMR analysis; [b]43% isolated yield plus 11% from DMP oxidation of 33a. [c]~15% of 34a and 34b.

cf



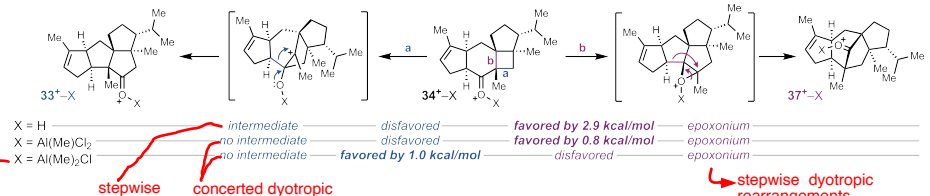


Figure 1. Computational results on mechanisms of the Cargill rearrangements.

further increased donor ability of the oxygen with Et2AlCl to push the alkyl group migration to form 33.

"a set of conditions were developed to get either the bridged or fused product via the Cargill rearrangement."